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NAVAER 01-60JKE-502

6 86

Handbook

Maintenance Instructions

NAVY MODEL

FJ-4B

AIRCRAFT

SECTION VIII
ELECTRICAL SYSTEMS

PUBLISHED BY DIRECTION OF
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Introduction to SECTION VIII

THIS HANDBOOK IS ONE OF A SERIES OF TEN which contain instructions required by using activities for the maintenance of Model FJ-4B aircraft. These are systems type handbooks. Each system is covered completely in a particular handbook. This includes all hydraulic, pneumatic, mechanical and electrical portions of the system. This has been done in order to assist the mechanic in becoming familiar with and in maintaining all phases of each system.

This handbook contains information necessary for the performance of class C and class D maintenance on those items of Contractor Furnished Equipment for which there are no separate handbooks. This handbook does not contain instructions for the overhaul of components. Such instructions are contained in separate handbooks of overhaul instructions for the individual components.

Instructions for the repair of aircraft structure are contained in the Handbook of Structural Repair (NAVAER 01-60JKD-503) for these aircraft.

Data necessary for obtaining replacement parts and for complete identification of parts are contained in the Illustrated Parts Breakdown (NAVAER 01-60JKD-504) for these aircraft.

Weight and Balance Data are found in the applicable AN 01-1B-40 handbook for each of these aircraft.

To identify and obtain these publications and handbooks covering separate items of equipment, refer to the Naval Aeronautic Publications Index (NAVAER 00-500).

BuAer Serial Numbers 139531 through 139555, 141444 through 141489 and 143493 through 143643 have been assigned to the FJ-4B. In addition, a lower case letter has been made a part of each serial number as it is painted on the aircraft. These lower case letters have been assigned to blocks of serial numbers as follows:

SERIAL NUMBER	LETTER
139531 through 139555	i
141444 through 141489	j
143493 through 143542	k
143543 through 143593	l
143594 through 143643	m

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GENERAL INFORMATION

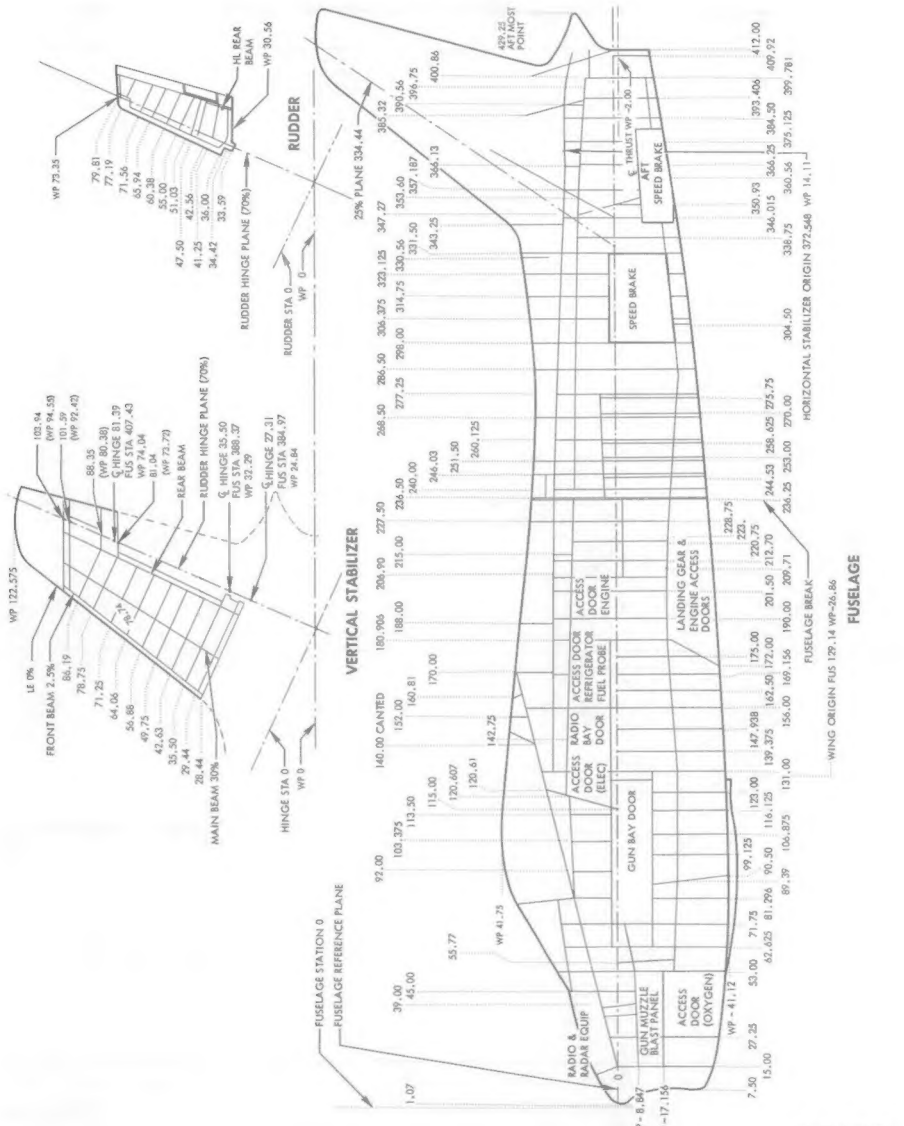

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Figure No. 8-1. Airplane Stations (Sheet 1)

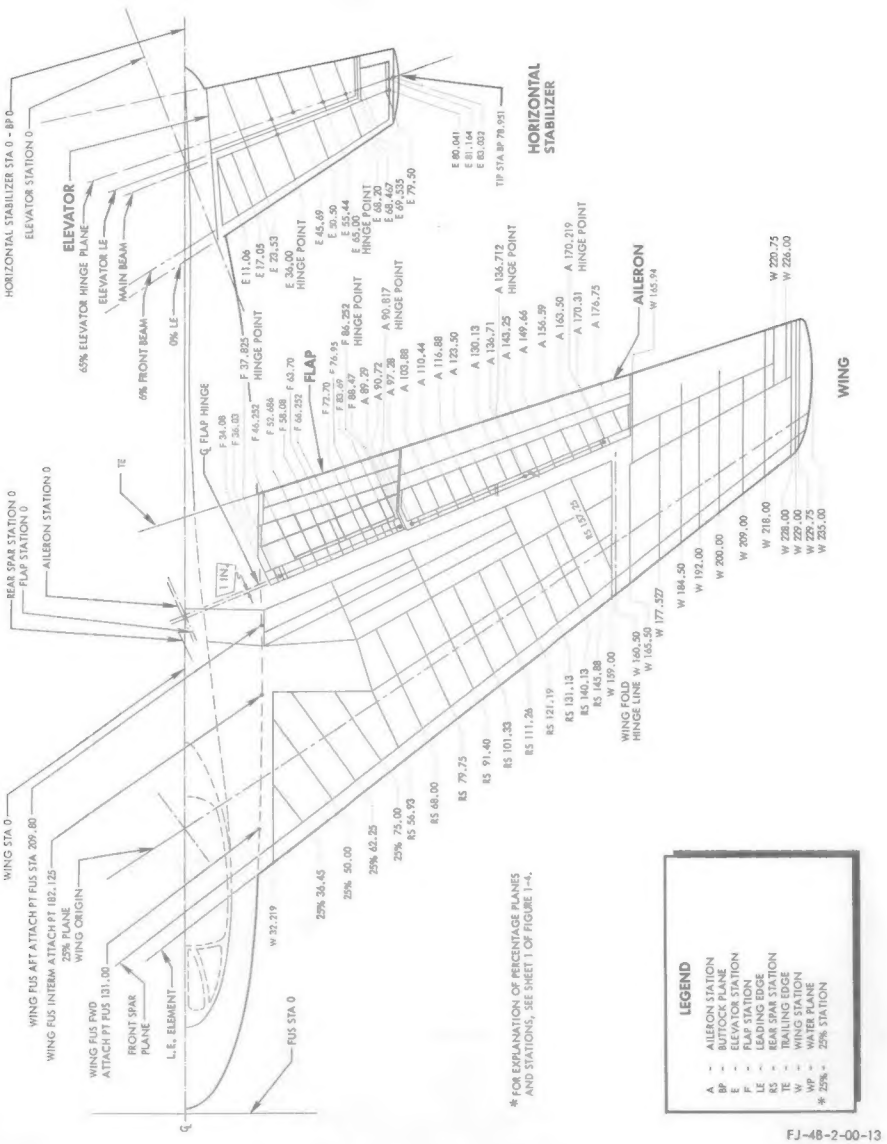


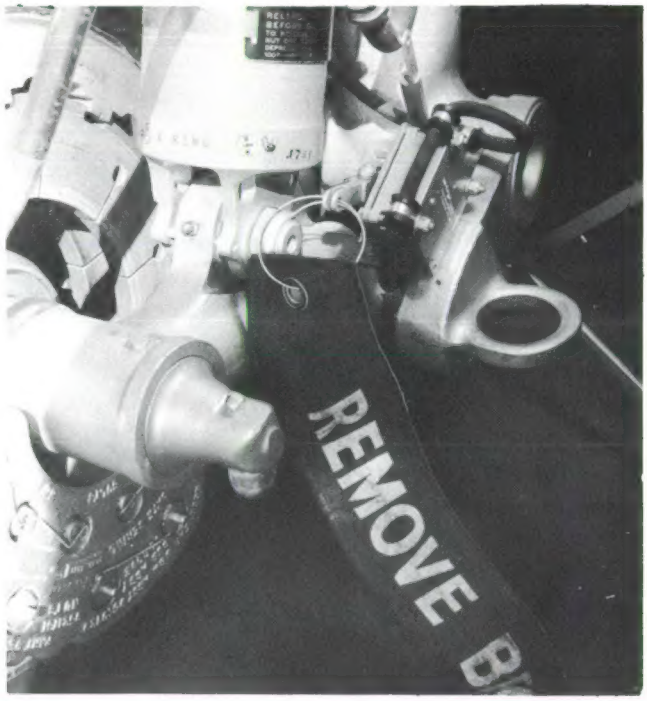
Figure No. 8-1. Airplane Stations (Sheet 2)

Warning Ground safety locks and pins are to be installed at all times, except for flight and gear retraction check. Remove immediately before flight and stow in cockpit map case.

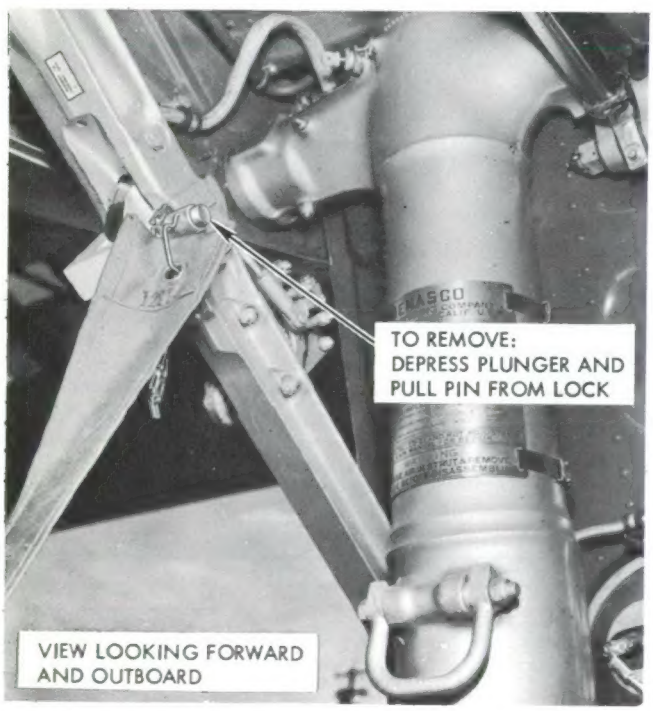
A time-saving method for performing certain testing procedures on the airplane (which normally would require the use of ground jacks) may be accomplished by disabling the ground safety switch. Attach a red warning flag, similar to the flags used on the landing gear ground safety locks, whenever the ground safety switch is disabled.

Warning When a red warning flag has been attached to the ground safety switch to indicate a disabled switch, never remove flag from the unit until switch has been properly connected.

GROUND SAFETY SWITCH



NOSE LANDING GEAR GROUND SAFETY LOCK



MAIN LANDING GEAR GROUND SAFETY LOCK

Note There is no ground safety lock for the arresting gear.

Figure No. 8-2. External Ground Safety Locks and Pins

Warning

- Keep out of the cockpit unless maintenance is required.
- Always consider the emergency escape system loaded and armed.
- Know where the safety pins are and be certain of their installation.
- Do not manipulate linkage wihout full knowledge of the emergency escape system.
- Do not use linkage or handles as handgrips.
- The catapult cartridge, canopy remover, remover initiators and exactor are ordnance items and should be checked and maintained only by qualified personnel.

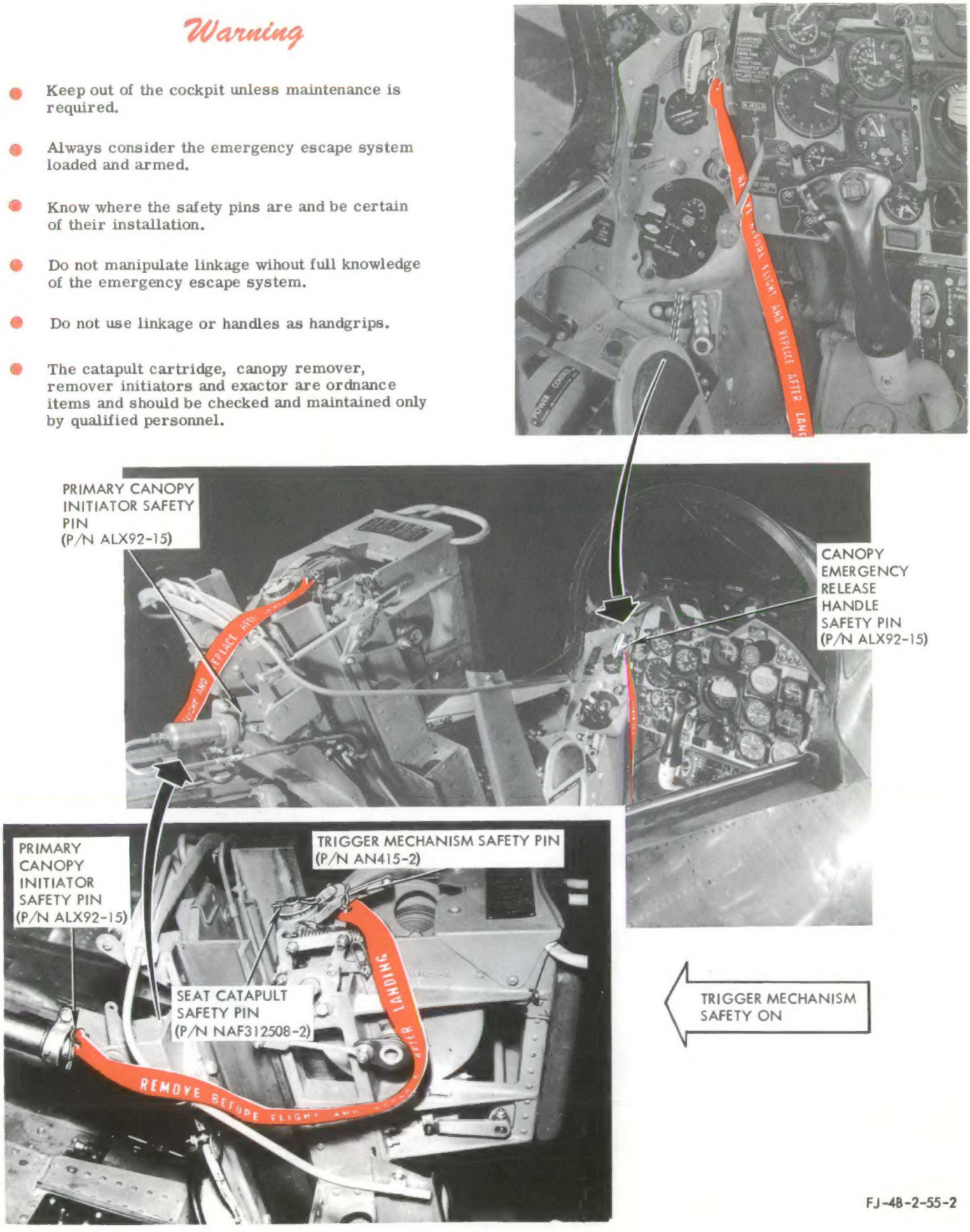
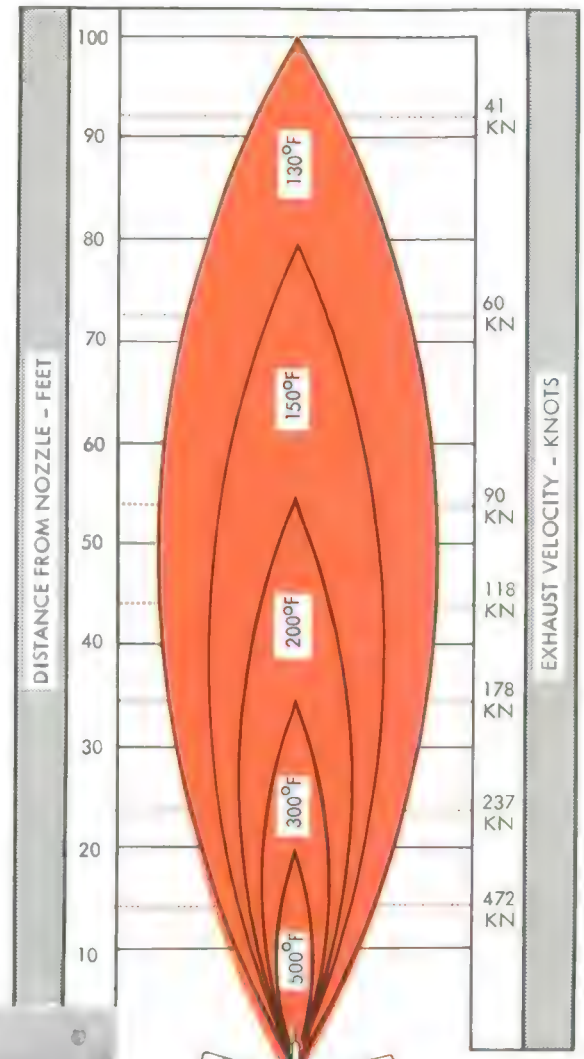


Figure No. 8-3. Emergency Escape System Ground Safety Pins

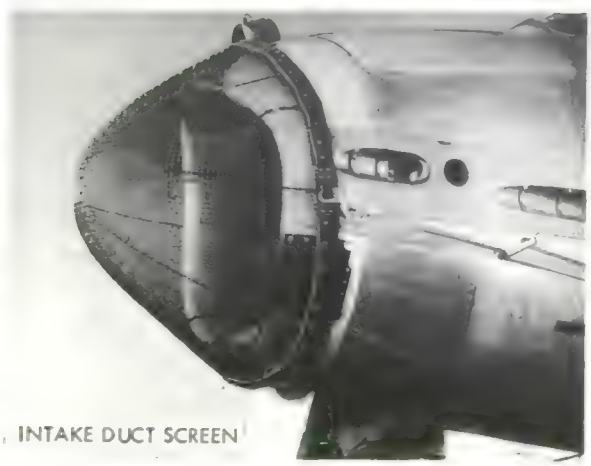
Warning

- Do not stand near the front of the air inlet duct while the engine is operating.
- Always approach the airplane from the side but not in the plane of rotation of the turbine when the engine is running.
- Avoid wearing hats or other loose clothing when working in the run-up area.
- Do not carry loose articles such as pencils, key rings or tools when near the air inlet duct.
- Do not foolishly experiment with the margin of safety by standing near, or feeling with your hand, the suction created by the engine.
- Do not stand on wing of the airplane while engine is operating, unless assistance is required during cockpit check-out or functional check of equipment.
- The loudest sustained noise produced by man is the noise of a jet engine operating at high rpm. Jet-engine noise is dangerous to personnel working in the immediate area. At distances from 50 to 200 feet, wear ear plugs and at distances within a radius of 50 feet, wear ear plugs and a type of over-the-ear protector. Prolonged exposure to jet-engine noise can cause pain and damage to the inner ear. Other effects of prolonged exposure are fatigue, nervousness and impairment of hearing.
- Do not stand at the edge of the blast area as the temperature could suddenly increase with engine speeds.



Place retaining rope hook in existing hole located in forward frame of step.

ATTACH POINT AT STEP



INTAKE DUCT SCREEN

Caution The area in front of the air inlet duct should be swept clean to minimize the possibility of dirt or other objects being drawn into the compressor and damaging the engine.

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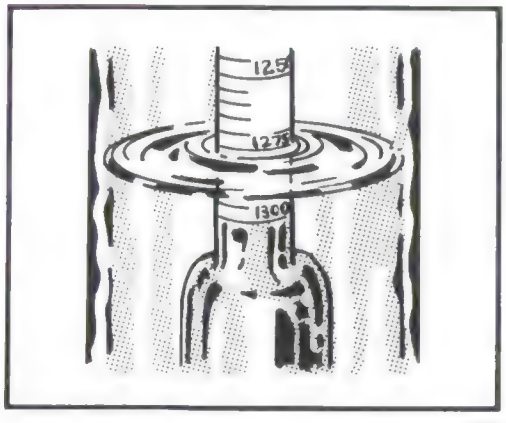
Figure No. 8-4. Ground Run-up Danger Areas



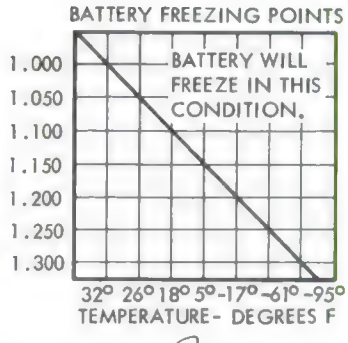
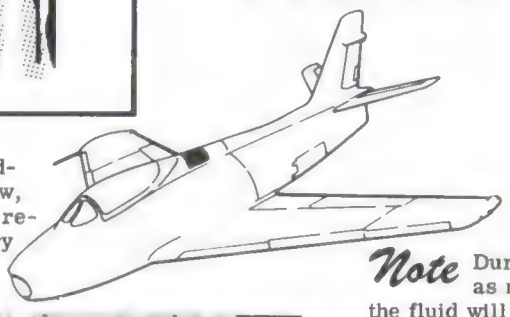


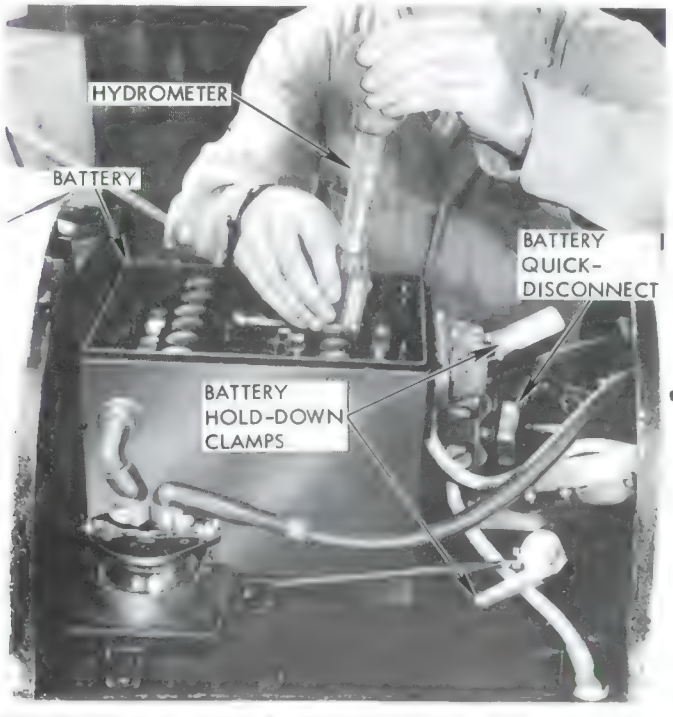
TABLE OF TEMPERATURE CORRECTIONS	
ELECTROLYTE TEMPERATURE (°F)	SPECIFIC GRAVITY CORRECTION POINTS
140	0.024
130	0.020
120	0.016
110	0.012
100	0.008
90	NO COR REQD
80	NO COR REQD
70	NO COR REQD
60	-0.008
50	-0.012
40	-0.016
30	-0.020
20	-0.024
10	-0.028
00	-0.032
10	-0.036
20	-0.040
30	-0.044

Note Temperature corrections must be made to ensure accurate readings.

Note If specific gravity readings are 1.240 or below, the battery must be replaced or recharged. A fully charged battery should read between 1.275 and 1.300.

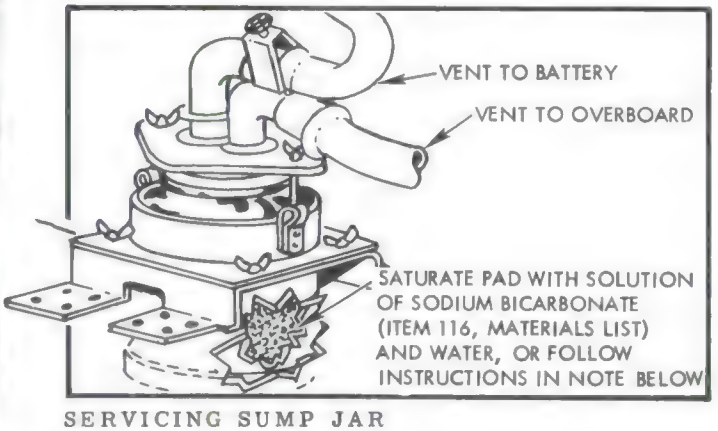


Note During cold weather, the battery must be kept as near fully charged as possible; otherwise the fluid will freeze. The battery should be removed and stored in a warm place when the airplane is to be parked for more than 4 hours at temperatures below -20°F or for an extended period.



SERVICING BATTERY

1. Remove battery access cover on top of fuselage at aft end of canopy.
2. Release battery hold-down clamps and remove cover from battery.
3. Take hydrometer reading of the fluid in each cell to determine condition of battery.
4. If specific gravity is satisfactory, add distilled water to each cell as necessary, being careful not to overfill. The correct level of the fluid is 3/8 inch above the plate and separator protector.



SERVICING SUMP JAR

1. Remove the two wing nuts that hold the cover to the container. Remove jar from container.
2. Pour off any liquid. Check the chemical condition of the sponge with blue litmus paper.

Note Touch moistened blue litmus paper to sponge. If the paper turns red, it is then necessary to reactivate the sponge by thorough washing and drying, and then immersing the sponge in a saturated solution of trisodium phosphate (item 135, materials list) and boiling water. Allow sponge to cool before replacing it in jar.

3. Reinstall jar.

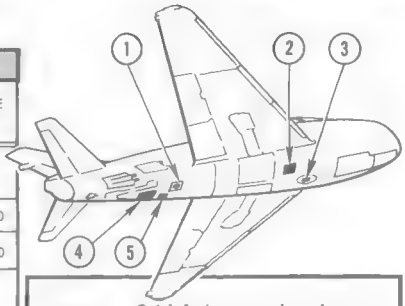
Warning Electrolyte in lead-acid batteries is made of one part chemically pure sulphuric acid and three parts water by volume. Be careful not to spill on body, clothing or equipment. If this does occur, immediately neutralize the affected area with a solution of sodium bicarbonate (item 116, materials list).

FJ-48-2-00-40

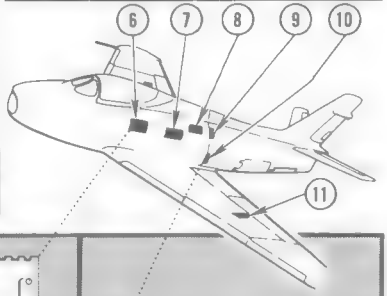
Figure No. 8-5. Servicing Battery and Sump Jar

TABLE

DOOR NO.	FASTENER MFG.	STUD PART NO.	STUD LENGTH IN INCHES	NO. REQD	RECEPTACLE PART NO.
1-2-5	DZUS	UF5T20	0.710	ONE EACH DOOR	URF5
3	AIRLOC	98265-2-190	0.609	1	99947-P.130
4	AIRLOC	98265-2-210	0.609	12	99947-P.130
6*	DZUS	UF5T30 URST40 UF5T50	0.810 0.910 1.010	4 4 6	URF5
7*	DZUS	UF5T20	0.710	9	URF5
8*	DZUS	UF5T20	0.710	5	URF5
9*	AIRLOC	98265-3-290 98265-2-160 98265-1-120 98265-3-310 98265-1-140 98265-2-250	0.719 0.609 0.500 0.719 0.500 0.609	1 1 2 1 1 1	99833-P.130
10*	AIRLOC	98265-1-150 98265-2-170	0.500 0.609	3 3	99833-P.130
11*	AIRLOC	98265-3-290	0.719	18	99947-P.130



Note Quick fasteners such as dzus, Airloc's and Camloc's (4002) are in locked position when slot in stud is aligned with painted black stripe on mating surface.



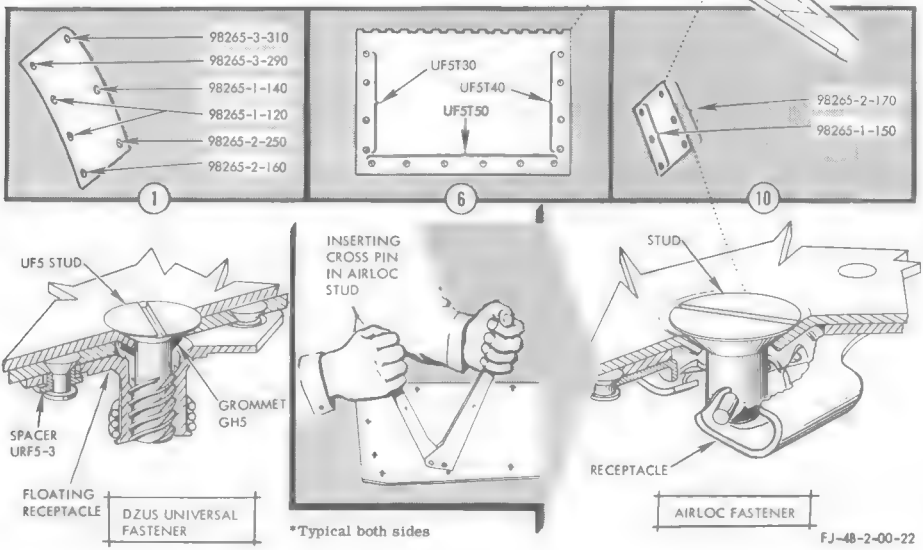
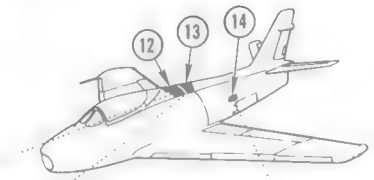
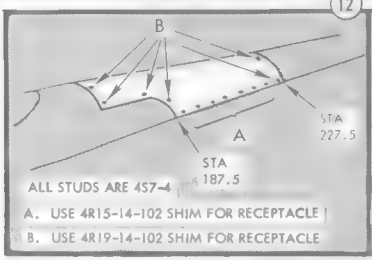
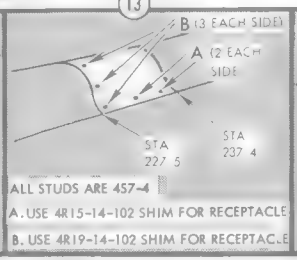


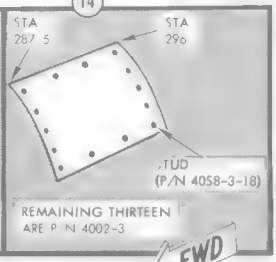
Figure No. 8-6. Access Door Fasteners (Sheet 1)

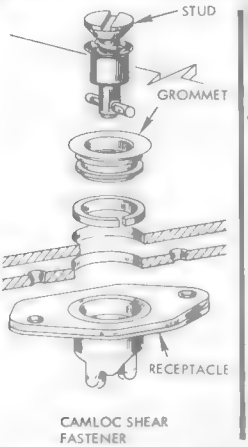
TABLE				
DOOR NO.	FASTENER MFG	STUD PART NO.	NO. REQD	RECEPTACLE PART NO.
12	CAMLOC	457-4	13	4R1-14
13	CAMLOC	457-4	10	4R1-14
14	CAMLOC	4002-3 40S8-3-18	13 1	214-16



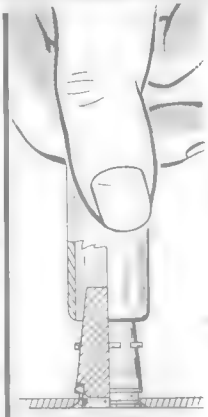






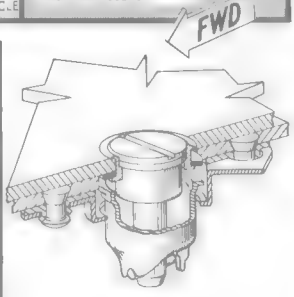


CAMLOC SHEAR FASTENER



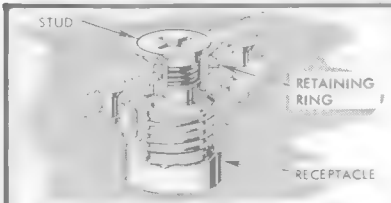
INSTALLING SNAP RING ON GROMMET

INSTALLING STUD IN GROMMET



CAMLOC SHEAR FASTENER INSTALLED

Note For adjustment of access doors fastened with latches, refer to paragraph 2-8.



CAMLOC STRESSED PANEL FASTENER (SPF)

OPERATION OF CAMLOC (SPF) FASTENERS

To Unfasten:
- Turn left at least one-half turn.

To Fasten:
- Push stud in and turn right until tight. Torque stud to approximately 40 inch-pounds.
- If stud pops out, push in, turn left one-half to one full turn; then, still pushing in, turn right until tight.

Caution Do not use a power driver on these fasteners.

Note Use No. 2 Phillips screwdriver on Camloc (SPF) fasteners.

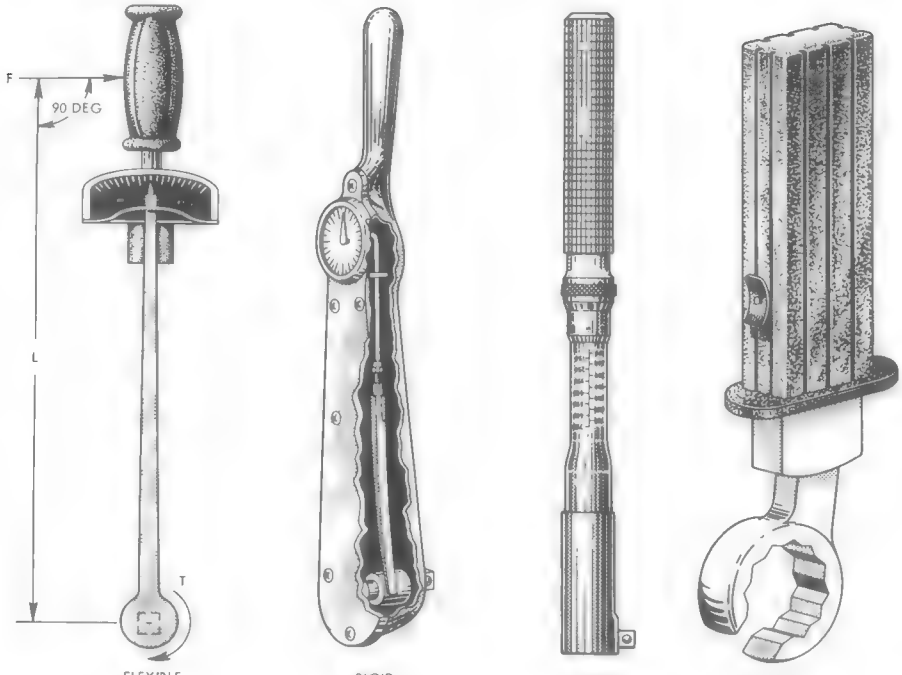
FJ-4B-2-00-23A

Figure No. 8-6. Access Door Fasteners (Sheet 2)

CABLE SIZE	BOLT SIZE		ALUMINUM OR CADMIUM PLATED WASHER SIZE		TORQUE VALUES (INCH-POUNDS)			
					ALUMINUM TERMINAL		COPPER TERMINAL	
	FINE THREAD	COARSE THREAD	I.D. (INCHES)	O.D. (INCHES)	FINE THREAD	COARSE THREAD	FINE THREAD	COARSE THREAD
8	1/4 - 28	1/4 - 20	1/4	7/16	46 ± 2	36 ± 2	46 ± 2	36 ± 2
8	5/16 - 24	5/16 - 18	5/16	9/16	50 ± 2	50 ± 2	75 ± 2	60 ± 2
8	3/8 - 24	3/8 - 16	3/8	9/16	40 ± 2	40 ± 2	85 ± 2	95 ± 2
6	1/4 - 28	1/4 - 20	1/4	1/2	46 ± 2	36 ± 2	46 ± 2	36 ± 2
6	5/16 - 24	5/16 - 18	5/16	5/8	50 ± 2	50 ± 2	75 ± 2	60 ± 2
6	3/8 - 24	3/8 - 16	3/8	5/8	60 ± 2	60 ± 2	125 ± 5	110 ± 2
4	1/4 - 28	1/4 - 20	1/4	9/16	46 ± 2	36 ± 2	46 ± 2	36 ± 2
4	5/16 - 24	5/16 - 18	5/16	9/16	50 ± 2	50 ± 2	75 ± 2	60 ± 2
4	3/8 - 24	3/8 - 16	3/8	5/8	60 ± 2	60 ± 2	125 ± 3	110 ± 3
2	1/4 - 28	1/4 - 20	1/4	11/16	46 ± 2	36 ± 2	46 ± 2	36 ± 2
2	5/16 - 24	5/16 - 18	5/16	11/16	75 ± 2	60 ± 2	75 ± 2	60 ± 2
2	3/8 - 24	3/8 - 16	3/8	11/16	80 ± 2	80 ± 2	145 ± 5	110 ± 3
1	1/4 - 28	1/4 - 20	1/4	13/16	46 ± 2	36 ± 2	50 ± 2	46 ± 2
1	5/16 - 24	5/16 - 18	5/16	13/16	75 ± 2	60 ± 2	75 ± 2	60 ± 2
1	3/8 - 24	3/8 - 16	3/8	13/16	130 ± 3	110 ± 3	145 ± 5	110 ± 3
0	1/4 - 28	1/4 - 20	1/4	7/8	50 ± 2	40 ± 2	50 ± 2	46 ± 2
0	5/16 - 24	5/16 - 18	5/16	7/8	75 ± 2	60 ± 2	75 ± 2	60 ± 2
0	3/8 - 24	3/8 - 16	3/8	7/8	130 ± 5	110 ± 2	145 ± 2	110 ± 3
0	7/16 - 20	7/16 - 14	7/16	7/8	225 ± 5	170 ± 5	225 ± 5	180 ± 5
0	1/2 - 20	1/2 - 13	1/2	7/8	275 ± 5	275 ± 5	360 ± 5	280 ± 5
00	4 - 28	1/4 - 20	1/4	15/16	50 ± 2	40 ± 2	50 ± 2	46 ± 2
00	5/16 - 24	5/16 - 18	5/16	15/16	75 ± 2	60 ± 2	75 ± 2	60 ± 2
00	3/8 - 24	3/8 - 16	3/8	15/16	145 ± 3	110 ± 3	145 ± 5	110 ± 3
00	7/16 - 20	7/16 - 14	7/16	15/16	225 ± 5	175 ± 5	225 ± 5	180 ± 5
00	1/2 - 20	2 - 13	1/2	15/16	275 ± 5	275 ± 5	360 ± 5	280 ± 5
000	3/8 - 24	3/8 - 16	3/8	1-1/16	145 ± 3	110 ± 3	150 ± 3	140 ± 3
000	2 - 20	1/2 - 3	1/2	1-1/16	355 ± 5	275 ± 5	400 ± 5	360 ± 5

FJ-4B-2-54-94A

Figure No. 8-7. Torque Values for Electrical Terminals

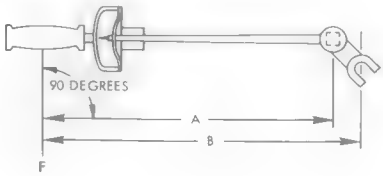


Basic formula F x L = T

F = Applied force

L = Lever length between centerline of drive and centerline of applied force (F must be 90 degrees to L)

T = Torque



Formula for use with extensions $Tw = \frac{Te \times A}{\blacksquare}$

A = Lever length of wrench

■ = Lever length of wrench plus extension

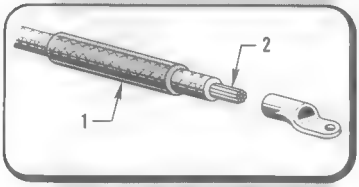
Te = Required torque on bolt

Tw = Torque reading on wrench dial

Note It is not advisable to use a handle extension on a flexible beam type torque wrench at any time. A handle extension alone has no effect on the reading of the other types. The use of a drive end extension on any type of torque wrench makes the use of the formula mandatory. When applying the formula, force must be applied to the handle of the torque wrench at the point from which the measurements were taken. If this is not done, the torque obtained will be in error.

FJ-48-2-00-5

Figure No. 8-8. Computing Torque Values



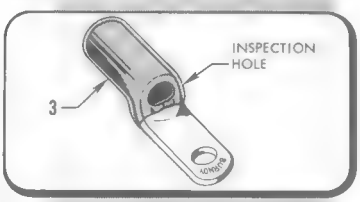
1 Install approximately 2 inches of insulating tubing (Specification MIL-I-631) of sufficient diameter to fit snugly over the terminal barrel on cable.

2 Using a knife, remove wire insulation 1/32 inch to 1/16 inch greater than the length of the terminal barrel.

3 Remove protective plastic cap or tin foil from terminal barrel.

4 Hold finger over inspection hole of terminal and insert cable, forcing Penetrox between and around cable strands.

Note The cable must be inserted into the terminal barrel so that the cable end is adjacent to, and visible through, inspection hole.

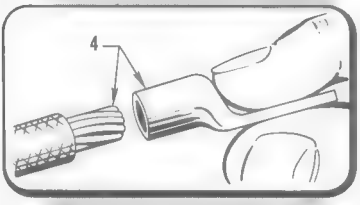


5 Wipe the excessive Penetrox from the cable and terminal.

6 With the indenting tool closed, release the Allen head adjustment locking setscrew. Move knurled adjusting screw to permit insertion of a gage section, corresponding to the terminal size required, between the nest and the indenter. Tighten the knurled adjusting screw handtight. Open the tool, remove the gage, and tighten the Allen head adjustment locking setscrew.

Note If gage is not available, it may be fabricated locally as shown.

Note Disregard position of index line on indexing plate.

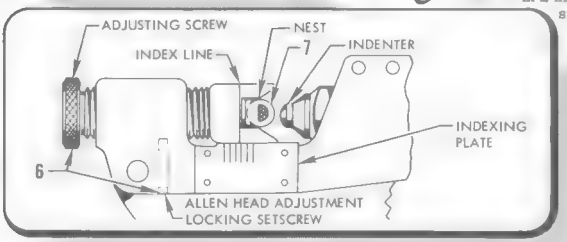


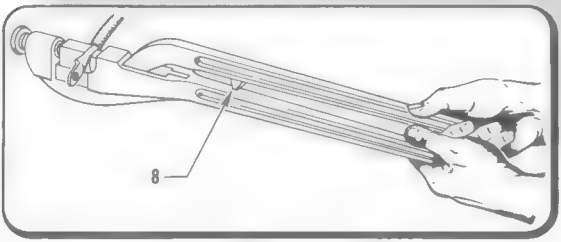
7 Insert the terminal and wire assembly into the nest from either side, with the top of the barrel toward the indenter.

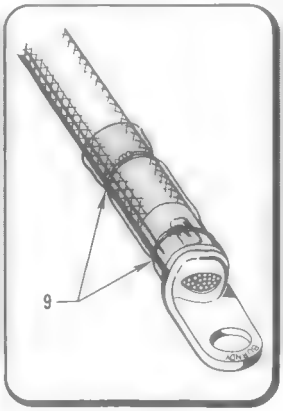
8 Indent at the center of the terminal barrel by closing the tool handles until the stop on the movable handle meets the lower handle.

9 Slide the insulating tubing over the barrel and spot-tie to hold in place

Caution Noncompliance with this procedure may result in a high resistance installation causing excessive heat and possible fire.







FJ-48-2-54-95

Figure No. 8-9. Installation Procedures for Attaching Aluminum Terminals to Aluminum Cables—Sizes 8 through 0 (Sheet 1)

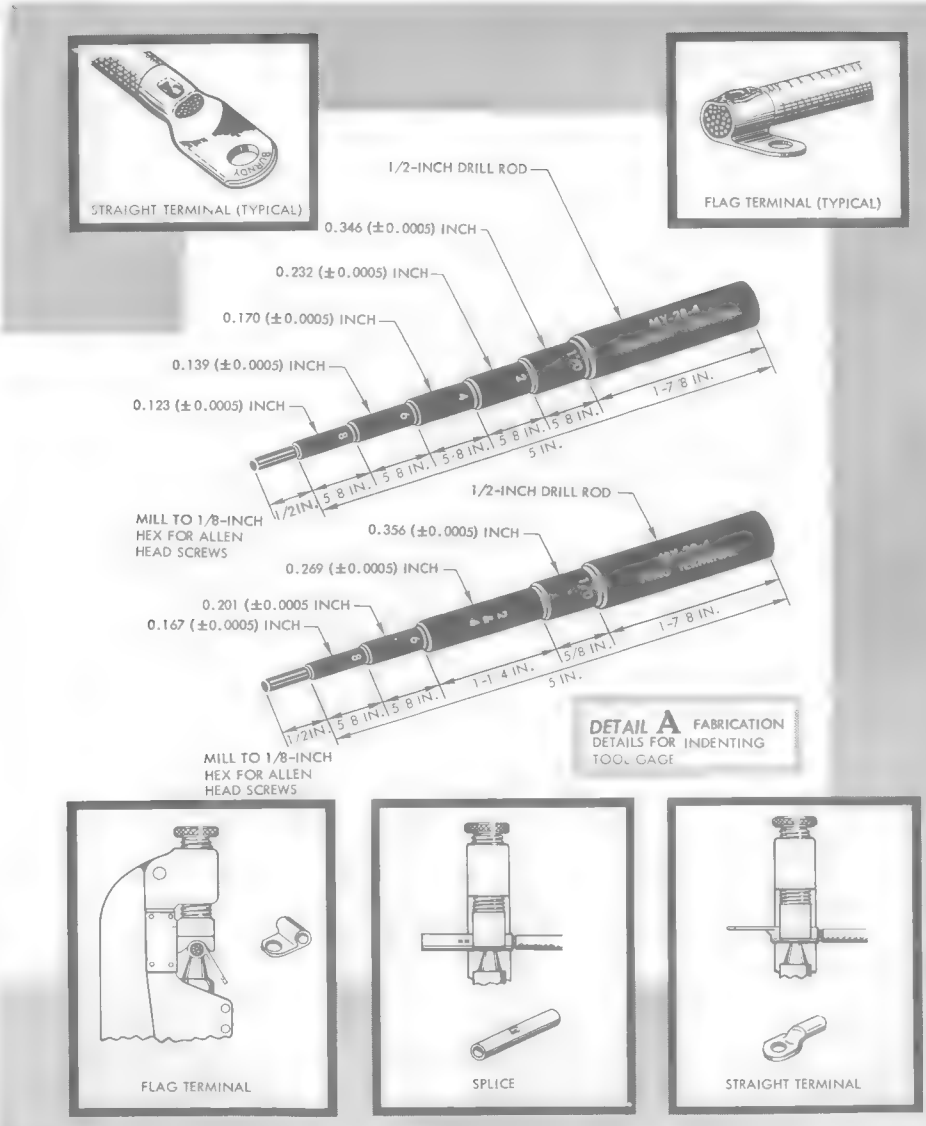
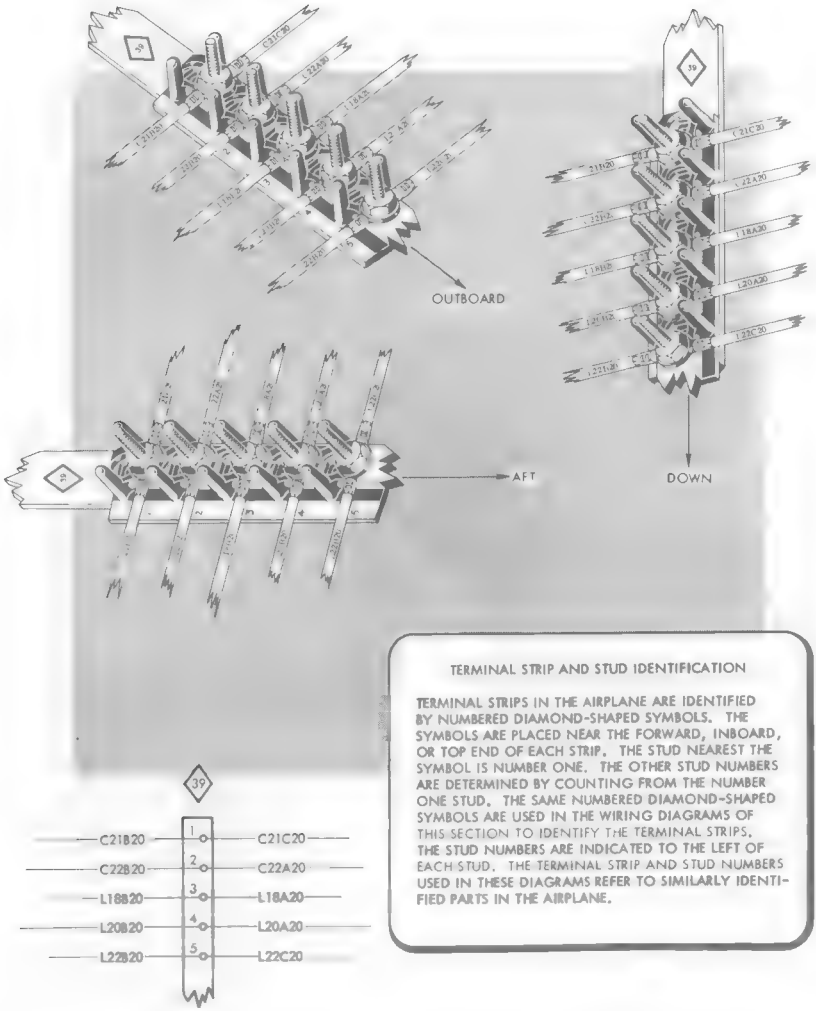


Figure No. 8-9. Installation Procedures for Attaching Aluminum Terminals to Aluminum Cables—Sizes 8 through 0 (Sheet 2)



TERMINAL STRIP AND STUD IDENTIFICATION

TERMINAL STRIPS IN THE AIRPLANE ARE IDENTIFIED BY NUMBERED DIAMOND-SHAPED SYMBOLS. THE SYMBOLS ARE PLACED NEAR THE FORWARD, INBOARD, OR TOP END OF EACH STRIP. THE STUD NEAREST THE SYMBOL IS NUMBER ONE. THE OTHER STUD NUMBERS ARE DETERMINED BY COUNTING FROM THE NUMBER ONE STUD. THE SAME NUMBERED DIAMOND-SHAPED SYMBOLS ARE USED IN THE WIRING DIAGRAMS OF THIS SECTION TO IDENTIFY THE TERMINAL STRIPS. THE STUD NUMBERS ARE INDICATED TO THE LEFT OF EACH STUD. THE TERMINAL STRIP AND STUD NUMBERS USED IN THESE DIAGRAMS REFER TO SIMILARLY IDENTIFIED PARTS IN THE AIRPLANE.

FJ-4-2-54-16A

Figure No. 8-10. Terminal Strip Identification

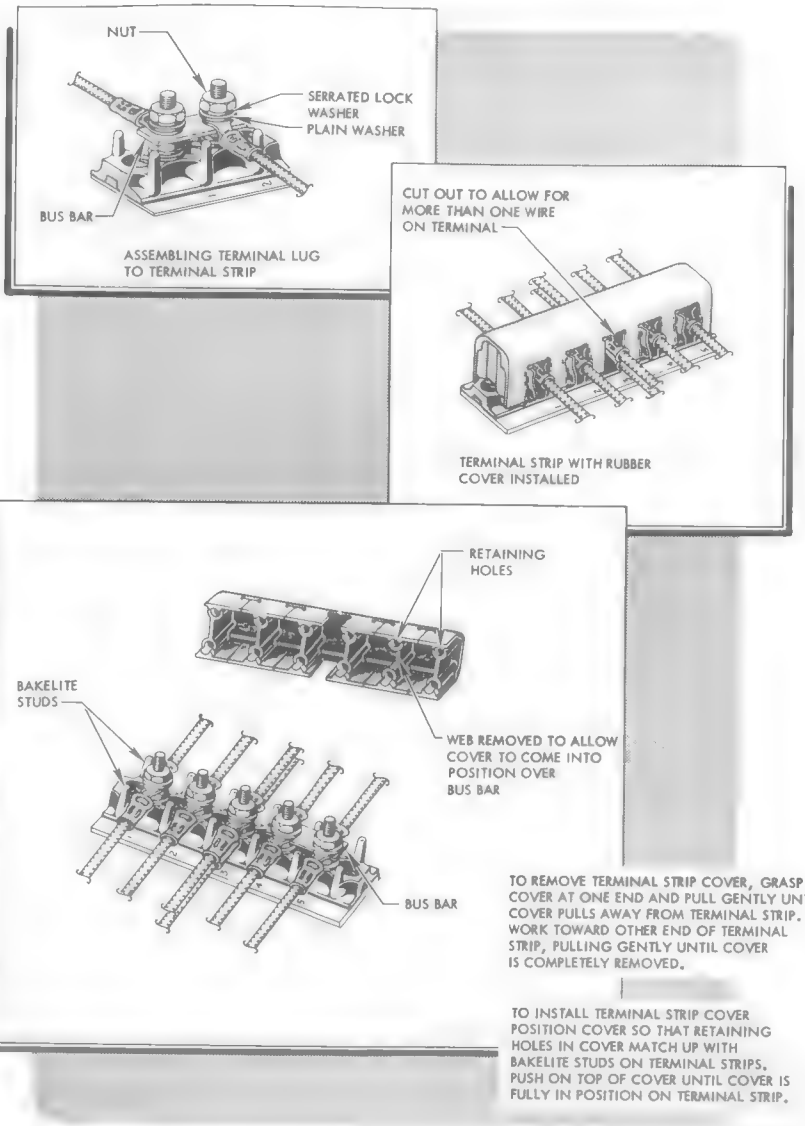
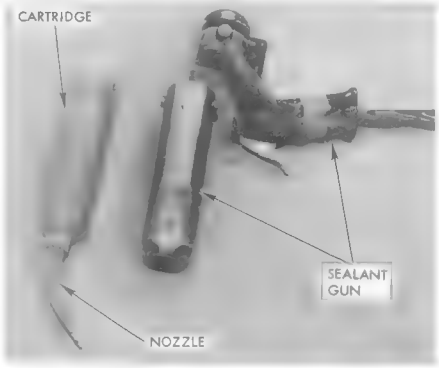


Figure No. 8-11. Terminal Strip Covers

POTTING PROCEDURE FOR "AN" TYPE ELECTRICAL CONNECTORS

Potting compound (item 114, materials list) is applied to connectors in a semi-liquid form and allowed to cure before using the assembly. Its use is limited to areas where the temperature under operating conditions does not exceed 220°F. Curing time at room temperature (75°F) is approximately 24 hours, while at elevated temperatures (120°F maximum) the curing rate is accelerated to as low as 3-1/2 hours. Accelerated curing can be accomplished by using a controlled warm air blast or by using an infrared heat lamp if accurate temperature readings can be maintained. Above 120°F, the sealant expands excessively and becomes porous. The useful life of the mixed sealant is quite short (90 minutes at 75°F) and care should be taken to mix only as much as is needed. Useful life of the mixture decreases by 50 percent for each 10°F increase in ambient temperature and increases inversely for each 10°F decrease in ambient temperature. The mixed sealant can be stored in dry ice at -29°F, in which case its work life is extended to 36 hours. However, if increased useful life is required, the time consumed in cooling and warming the mixture must be subtracted from its life limits for the operation. If cooling is desired, it should be done immediately after mixing, and warming should be accomplished by allowing 80 minutes for the mixture to come to a room temperature of 75°F. The mixture will be ruined if artificial direct heat is used to raise the temperature. Shelf storage should be confined to areas where temperature can be controlled to 70°F or below. The following materials are required to perform the potting operation:

1. Compound kit Stock No. R52-X-3258-250 (with toothpaste type tube for application), or Stock No. R52-C-3258-260 (one-quart container), or Stock No. R52-C-3258-270 (one-gallon container).
2. Spatula or mixing tool locally manufactured from welding rod or wooden paddle.
3. Gloves to protect the hands from volatile solvents.
4. "O" rings to fit the connectors.
5. Paper towel or sheet of white paper.
6. Masking or cellophane tape.
7. Curing rack, locally manufactured, to suitably hold required number of connectors with wires in upright position.
8. Sealant gun, presently obtainable from Semco Research, Inc, Model No. 250-02-1/2, or equivalent.
9. Accessories for sealant gun and compressed air supply.
10. Small dowel rod for tamping.
11. Safety solvent (item 120, materials list) or equivalent.
12. Turco High Flash Penetrol solvent or naphtha (item 91, materials list) for cleaning connectors.
13. Methylene chloride (item 46, materials list).
14. Small tags to be used for recording exact potting time and date.



Normal fire precautions should be used during mixing and potting operations since the compound is slightly inflammable. After the potting compound is prepared, it can be applied with a pressure sealant gun or, if such a gun is not available, with a small spatula. However, do not attempt to pot 90-degree angle plugs with a spatula since these plugs require that the sealant be applied under pressure to reach the pins. When potting with a spatula, use the small dowel rod for tamping the sealant solidly around the pins. With either method of application, tap the connector sharply with a wooden block during and immediately after application of compound. This tapping tends to settle the compound into small recesses and to remove air bubbles.

FJ-48-2-54-85

Figure No. 8-12. Potting Procedures for AN Type Electrical Connectors (Sheet 1)

It is very important that tapping be done vigorously and repeatedly to assist settling and removal of air bubbles. The only alternative to this operation is the use of mechanical shaker or vibrator capable of producing vibrations up to 0.050-inch magnitude at the connector.

Connectors must be supported in an upright position to prevent spilling the sealant during tapping and curing. This is best accomplished by using a drying rack which is equipped with clamps for both cables and connectors.

PREPARATION OF POTTING COMPOUND

Thoroughly mix the base compound and accelerator separately before mixing them together. This will ensure more uniform work life and flow characteristics. Then, thoroughly mix the accelerator into the base compound. Due to the heat generated in the compound during the mixing process, it is advisable to mix slowly and not beyond the point where tests show the accelerator to be thoroughly blended with the base compound. Mixing should usually require from 7 to 10 minutes. It is very important that the base compound and accelerator be left together in the container when stored since small chemical differences between different batches of accelerator and base compound can produce a substandard product if mixed indiscriminately. It is also important to mix all of the accelerator provided with the base compound. The compound can be mixed either by hand, with a spatula, or mechanically with a drill press geared to no higher than 50 rpm. A small drill rod may be inserted into the drill press for the operation. The compound must be mixed until it is completely smooth and no flecks are present. It is tested for this quality by using the spatula to place a small smear of the compound on a sheet of white paper. If flecks or streaks occur, the compound requires more mixing. After the mixing is finished, the compound should either be used immediately or placed in cold storage immediately.

PREPARATION OF CONNECTORS (GENERAL).

Most AN type connectors have a back shell which extends considerably beyond the pin solder cups. The potting compound is applied on these connectors to the top of the back shell. However, AN3102 connectors, and certain split shell type AN3106 and AN3108 connectors, do not have this built-up shell. They require a built-up wall, preferably made by wrapping two or three turns of one-inch masking or cellophane tape around the stub of the connector so that a sufficient body of sealant can be applied to cover and support the wire ends. When using tape molds, grease the inside of the tape with vaseline to prevent the sealant from adhering to the tape. Modified AN type connectors, such as BuAer Drawing No. 54A3A225 and 54A3A224, have been designed especially for potting and are available in all sizes, and from some manufacturers complete with temporary potting molds. Both new and used connectors must be cleaned in a solvent before potting to assure that potting surfaces are absolutely free from grease and oil.

- Do not use insulating sleeving over wires on potted connectors. Use of sleeving is obviously not required, and in fact would prevent a proper sealing of the pins.
- Fill connectors to at least 1/4 inch over the end of the wire insulation, or to the top of the mold.

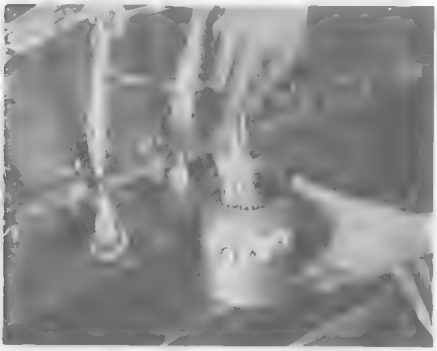
FJ-4B-2-54-86

Figure No. 8-12. Potting Procedures for AN Type Electrical Connectors (Sheet 2)

PREPARATION OF NEW CONNECTORS

New connectors should be prepared for potting in the following manner:

1. Remove shell or mold from connector.
2. Slide shell or mold on wire harness so that it will engage with the connector after wires are soldered.
3. Solder wires on connector using only a small electric soldering iron or gun. Solder 9-inch spare wires to all unused pins whose maximum capacity is a No. 8 gage wire or smaller, using the largest wire size that will fit into the pin.
4. Carefully clean off all excess rosin which remains on the pins after soldering. This is important since rosin produces a chemical reaction on the sealant, causing improper curing of the sealant.
5. Swish the connector into a container of safety solvent (item 120, materials list) or naphtha (item 91, materials list) and tap the connector repeatedly with a wooden block until all solvent is shaken out.



6. Apply a light film of lubricating oil to all exterior surfaces of the connector and to the interior surfaces of the mold to prevent the compound from adhering to the connector. Coat threads with anti-seize compound.
7. Support the assembly with connector hanging straight down so that the sealant will not flow over the edge of the connector when potted full.
8. Perform potting operation.
9. Record time and date on the small tag and secure tag to harness. The tag can be removed when connector is capable of being handled.

Note If accelerated curing is to be used, delay putting assembly in elevated temperature area for one-half hour after potting. This allows the compound to settle naturally before fast curing.

PREPARATION OF OLD CONNECTORS

Old connectors should be prepared for potting in the following manner:

1. Remove back shell.
2. Wipe existing grease and grime from connector, wires and shell and continue cleaning as in steps 3 through 7 under "Preparation of New Connectors."
3. Remove sleeving, if present, from wires and bundles.
4. Remove all excess rosin from pins and wires with a knife or stripping brush.
5. Saturate stripping brush with quantities of safety solvent (item 120, materials list) or naphtha (item 91, materials list) and use the brush to loosen and remove more grime and foreign materials.

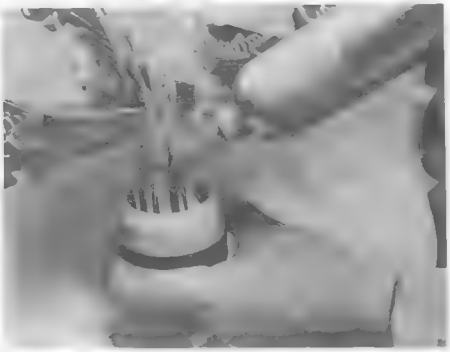
6. Allow assembly to dry thoroughly. Repeat step 5 at least twice to make sure that no grease or oil remains on surfaces to which the sealant must adhere.
7. Rinse the area to be potted with a small volume of methylene chloride (item 46, materials list) and allow to dry. Apply the methylene chloride with a small atomizer or similar device. .

Caution Use methylene chloride in a well ventilated area and do not breathe the fumes.

8. Perform any necessary repair on connector or wires and again remove excess rosin or flux. Solder spare wires into connector, using only a small electric soldering iron or gun.
9. Separate all wires evenly and support connector in an upright position with shell or built-up mold in place.
10. Perform potting operation.

FJ-48-2-54-87

Figure No. 8-12. Potting Procedures for AN Type Electrical Connectors (Sheet 3)



11 Record time and date on a small tag and secure tag to harness. The tag can be removed when connector is capable of being handled.

Note If accelerated curing is to be used, do not put assembly in elevated temperature area until one-half hour after potting. This allows the compound to settle naturally before fast curing.

REPAIRING POTTED CONNECTOR ASSEMBLIES

When single wires require repair, or pins are broken, a temporary fix may be made by using spare wires of the same size as the original or larger. However, if no such spare wires are available in the connector, it is necessary to either replace the entire connector and reseal it, or to probe for the discrepancy. It is preferable, and easier in most cases, to replace the connector, but if this is not possible, repair can be effected as follows:

1 Remove back shell, if present, by running a thin knife blade around the inside edge or, in the case of 90-degree angle connectors, loosen the shell mechanically and twist and pull the shell until it separates from the potting compound.

2 Gain access to wire and pin involved by first cutting into sealant with a knife to come close to the fault.

3 If fault is on a pin toward the center of the connector, it may be necessary to use a pair of long nosed pliers to tear pieces away from the surrounding pins and area. It should not be necessary to remove all the material.

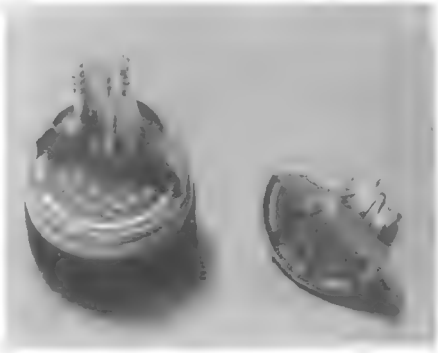
4 If the pin is damaged or broken and found to be unrepairable, the connector should be replaced.

Caution Do not attempt to use a pin which cannot be anchored to its proper position in the connector since intermittent contact and eventual complete failure will result.

5 If the wire is to be resoldered, use only a small clean electrical soldering iron or gun.

6 After soldering, clean any foreign material and rosin from the wire and pin.

7 Repot the connector in accordance with preceding instructions, pouring the compound on top of the existing sealant. The new compound will vulcanize completely with the existing sealant.



"O" RINGS

The sealing operation is not completely moistureproof without the use of rubber "O" rings. These "O" rings are inserted between plug and receptacle before the connectors are mated. The following chart lists procurement numbers for "O" rings to fit all AN connectors:

CONNECTOR SIZE	STOCK NUMBER	THICKNESS (INCHES)	INSIDE DIAMETER (INCHES)
8S	R33MS-29513-10	0.070	0.312
10S - 10SL	R33MS-29513-12	0.070	0.364
12 - 12S	R33MS-29513-14	0.070	0.489
14 - 14S	R33MS-29513-14	0.070	0.489
16 - 16S	R33MS-29513-16	0.070	0.614
18	R33MS-29513-18	0.070	0.739
20	R33MS-29513-20	0.070	0.864
22	R33MS-29513-22	0.070	0.989
24	R33MS-29513-24	0.070	1.114
28 - 32	R33MS-29513-28	0.070	1.364
36	R33MS-29513-132	0.103	1.737
40	R33MS-29513-136	0.103	1.987
44	R33MS-29513-140	0.103	2.237
48	R33MS-29513-144	0.103	2.487

FJ-48-2-54-88A

Figure No. 8-12. Potting Procedures for AN Type Electrical Connectors (Sheet 4)

WIRE SIZE	SCREW SIZE	AN659	T & B TERMINALS		AMP TERMINALS	
			TERMINAL	HAND TOOL	TERMINAL	HAND TOOL
22-18	4	-38	RA323	WT145	31878	49556
22-18	6	-1	RA853	WT145	31882	49556
22-18	8	-2	RA863	WT145	31888	49556
22-18	10	-2	RA873	WT145	31889	49556
22-18	1/4		RA713	WT145	31892	49556
22-18	5/16		RA723	WT145	31893	49556
22-18	3/8	-25	RA733	WT145	31896	49556
16-14	4	-39	RB323	WT145	32439	49557
16-14	4	-39	RB323	WT145	32441	49557
16-14	6	-3	RB1333	WT145	32440	49557
16-14	6	-26	RB1333	WT145	32442	49557
16-14	6	-3	RB853	WT145	31898	49557
16-14	6	-3	RB853	WT145	31901	49557
16-14	8	-4	RB863	WT145	31899	49557
16-14	8	-4	RB863	WT145	31902	49557
16-14	10	-4	RB873	WT145	31900	49557
16-14	10	-4	RB873	WT145	31903	49557
16-14	1/4		RB713	WT145	31906	49557
16-14	1/4		RB713	WT145	31904	49557
16-14	5/16		RB723	WT145	31907	49557
16-14	5/16		RB723	WT145	31905	49557
16-14	3/8	-27	RB733	WT145	31909	49557
16-14	3/8	-27	RB733	WT145	31908	49557
12-10	6		RC733	WT145	32542	59062
12-10	8	-5	RC863	WT145	32543	59062
12-10	10	-5	RC363	WT145	32544	59062
12-10	1/4		RC713	WT145	32545	59062
12-10	5/16	-6	RC703	WT145	32546	59062
12-10	3/8	-28	RC733	WT145	32547	59062

FJ-48-2-54-99

Figure No. 8-13. Approved Terminals and Crimping Tools for Wires—Sizes 22 through 00 (Sheet 1)

WIRE SIZE	SCREW SIZE	AN659	T & B TERMINALS		BURNDY TERMINALS		AMP TERMINALS (NON INSULATED)		
			TERMINAL	HAND TOOL	TERMINAL	HAND TOOL	TERMINAL	HAND TOOL NO 69020	
								NEST	INDENTER
8	10	-7	D-26	WT-115	YAEV8C-L	MY28-6 OR MY4-10	33460	48126	48355
8	1/4		D-71	WT-115	YAEV8C-L1	MY28-6 OR MY4-10	33461	48126	48355
8	5/16	-8	D-72	WT-115	YAEV8C-L2	MY28-6 OR MY4-10	33462	48126	48355
8	3/8	-28	D-73	WT-115	YAEV8C-L3	MY28-6 OR MY4-10	33463	48126	48355
6	10	-30	E-26	WT-115	YAEV6C-L1	MY28-6 OR MY4-10	33464	48128	48127
6	1/4	-9	E-71	WT-115	YAEV6C-L	MY28-6 OR MY4-10	33465	48128	48127
6	5/16	-31	E-72	WT-115	YAEV6C-L4	MY28-6 OR MY4-10	33466	48128	48127
6	3/8	-10	E-73	WT-115	YAEV6C-L2	MY28-6 OR MY4-10	33467	48128	48127
6	1/2			WT-115	YAEV6C-L10	MY28-6 OR MY4-10	36808	48128	48127
4	10		F-26	WT-115	YAEV4C-L3	MY28-6	33468	48129	48127
4	1/4	-11	F-71	WT-115	YAEV4C-L	MY28-6	33469	48129	48127
4	5/16	-32	F-72	WT-115	YAEV4C-L4	MY28-6	33470	48129	48127
4	3/8	-12	F-73	WT-115	YAEV4C-L2	MY28-6	33471	48129	48127
4	1/2				YAEV4C-L5	MY28-6	35668	48129	48127
2	10				YAEV2C-L3	MY28-6		48130	48127
2	1/4	-13	G-71 OR G-571	WT-115	YAEV2C-L1	MY28-6	320138	48130	48127
2	5/16		G-72 OR G-572	WT-115	YAEV2C-L2	MY28-6	35183	48130	48127
2	3/8	-14	G-73 OR G-573	WT-115	YAEV2C-L	MY28-6	35184	48130	48127
2	1/2	-33	G-75 OR G-575	WT-115	YAEV2C-L4	MY28-6	35185	48130	48127
1	1/4	-15	H-71 OR H-571	21076 OR WT-127H	YAEV1C-L1	MY28-6			
1	5/16				YAEV1C-L2	MY28-6			
1	3/8	-16	H-73 OR H-573	21076 OR WT-127H	YAEV1C-L	MY28-6			
1	1/2	-34			YAEV1C-L3	MY28-6			
0	1/4	-17	J-71 OR J-571	21076 OR WT-127J	YAEV25-L1	MY28-6	36915	48132	48131
0	5/16		J-72 OR J-572	21076 OR WT-127J	YAEV25-L2	MY28-6	36916	48132	48131
0	3/8	-18	J-73 OR J-573	21076 OR WT-127J	YAEV25-L	MY28-6	36917	48132	48131
0	1/2	-35	J-75 OR J-575	21076 OR WT-127J	YAEV25-L3	MY28-6	36919	48132	48131
0	5/8				YAEV25-L4	MY28-6	36920	48133	48131
00	1/4				YAEV26-L1	MY28-6	36921	48133	48131
00	5/16	-19	K-72 OR K-572	21076 OR WT-127K	YAEV26-L2	MY28-6	36922	48133	48131
00	3/8	-20	K-73 OR K-573	21076 OR WT-127K	YAEV26-L	MY28-6	36923	48133	48131
00	1/2	-36			YAEV26-L3	MY28-6	36925	48133	48131
00	5/8				YAEV26-L12	MY28-6	36926	48133	48131

FJ-48-2-54-100A

Figure No. 8-13. Approved Terminals and Crimping Tools for Wires—Sizes 22 through 00 (Sheet 2)

CABLE SIZE	SCREW SIZE	STRAIGHT TERMINAL	* 90 DEGREE TERMINAL	** FLAG TERMINAL	HAND TOOL
8	8-10	YAV8CA-L	YAV8CA-R	YBM8C	MY28-4
8	1/4	YAV8CA-L1	YAV8CA-R1	YBM8C-T2	MY28-4
8	5/16	YAV8CA-L2	YAV8CA-R2	YBM8C-T3	MY28-4
8	3/8	YAV8CA-L3	YAV8CA-R3	YBM8C-T4	MY28-4
6	8-10	YAV6CA-L1	YAV6CA-R1	YBM6C-L9	MY28-4
6	1/4	YAV6CA-L	YAV6CA-R	YBM6C-L	MY28-4
6	5/16	YAV6CA-L4	YAV6CA-R4	YBM6C-L2	MY28-4
6	3/8	YAV6CA-L2	YAV6CA-R2	YBM6C-L3	MY28-4
4	8-10	YAV4CA-L3	YAV4CA-R3		MY28-4
4	1/4	YAV4CA-L	YAV4CA-R	YBM4C-L	MY28-4
4	5/16	YAV4CA-L4	YAV4CA-R4	YBM4C-L1	MY28-4
4	3/8	YAV4CA-L2	YAV4CA-R2	YBM4C-L2	MY28-4
2	8-10	YAV2CA-L3	YAV2CA-R3		MY28-4
2	1/4	YAV2CA-L1	YAV2CA-R1	YBM2C-L1	MY28-4
2	5/16	YAV2CA-L2	YAV2CA-R2	YBM2C-L2	MY28-4
2	3/8	YAV2CA-L	YAV2CA-R	YBM2C-L	MY28-4
1	1/4	YAV1CA-L1	YAV1CA-R1		MY28-4
1	5/16	YAV1CA-L2	YAV1CA-R2		MY28-4
1	3/8	YAV1CA-L	YAV1CA-R		MY28-4
0	8-10	YAV25A-L5	YAV25A-R5 OR YAV25A-S5		MY28-4
0	1/4	YAV25A-L1	YAV25A-R1 OR YAV25A-S1	YBM25-L1	MY28-4
0	5/16	YAV25A-L2	YAV25A-R2 OR YAV25A-S2	YBM25-L2	MY28-4
0	3/8	YAV25A-L	YAV25A-R OR YAV25A-S	YBM25-L	MY28-4
0	7/16	YAV25A-L16	YAV25A-R16 OR YAV25A-S16		MY28-4
00	1/4	YAV26A-L1	YAV26A-R1 OR YAV26A-S1		MY28-4
00	5/16	YAV26A-L2	YAV26A-R2 OR YAV26A-S2		MY28-4
00	3/8	YAV26A-L	YAV26A-R OR YAV26A-S	YBM26-L	MY28-4
00	7/16	YAV26A-L16	YAV26A-R16 OR YAV26A-S16		MY28-4
00	1/2	YAV26A-L3	YAV26A-R3 OR YAV26A-S3		MY28-4
000	3/8	YAV27A-L	YAV27A-R OR YAV27A-S		MY26-4
000	1/2	YAV27A-L1	YAV27A-R1 OR YAV27A-S1		MY28-4
0000	3/8	YAV28A-L	YAV28A-R OR YAV28A-S		MY28-4
0000	1/2	YAV28A-L12	YAV28A-R12 OR YAV28A-S12		MY28-4

* "-RS" TYPE TERMINALS MAY BE SUBSTITUTED FOR BOTH "-R" AND "-S" TYPES

** "YBV ( )" TYPE TERMINALS MAY BE SUBSTITUTED FOR "YBM ( )" TYPES

NOTE: ALL TERMINALS SHOWN ON THIS PAGE ARE MANUFACTURED BY BURNDY MFG CO.

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Figure No. 8-14. Approved Terminals and Crimping Tools for Aluminum Cables—Sizes 8 through 0000

COLD WEATHER MAINTENANCE OF ELECTRICAL EQUIPMENT.

Low temperatures aggravate electrical and electronic maintenance problems and lower the efficiency of servicing personnel. In general, equipment should always be serviced under as favorable conditions as possible. In this way, many borderline failures can be prevented. Prolonged exposure to cold causes servicing personnel to become clumsy. This factor can cause extensive damage to occur to equipment from being dropped and from inability to properly tighten hardware. Preventive maintenance is especially valuable in preventing system failure during cold weather.

Note

The following is a list of precautions which can facilitate preventive maintenance:

- Do not expose electrical and electronic access areas to snow or rain. Provide adequate shelter when opening access doors. Door hinges, electrical connectors, equipment fasteners, ventilated radio and radar equipment, cockpit console panels, electrical surface control actuators and, to a degree, all electrical components are extremely susceptible to failure when saturated with water condensation or ice.
- Avoid applying prying forces on cast metals and plastics such as electrical consoles, fastening strips, all electrical connectors, right-hand radio junction box, inverter and actuator mounting feet, switches, circuit breakers and electrical power and coaxial cables. These items are more brittle and are easily broken in cold weather.
- Store electrical and electronic equipment in warm areas to prevent breakdowns of electrolytic capacitors and coils inside.
- Do not use a blowtorch to preheat any electrical equipment.
- Never utilize battery power to test electrical components of any kind in cold weather. Use only a regulated external power source.
- Handle storage batteries with extreme care in cold weather. For cold weather maintenance and servicing, refer to paragraph 1-38.
- Do not overtorque bolts on electrical equipment. See figure 8-7 for correct torque values.
- Avoid breaking access seals, if possible, when operating under extreme temperature changes. In this way, condensation and frost can be minimized in the radar bay, the cockpit, radio and electrical bays and the top deck areas.

WIRING PROVISIONS.

The primary objective of the airplane's electrical wiring system is to obtain a low loss distribution of electrical power with the greatest amount of servicing ease. To obtain this objective, materials are used which will withstand the inherent operational stresses and hazards. Wire terminations are made into either electrical and coaxial connectors or solderless-type terminals. Wire junctions are accomplished by terminal strips. Duplicate power wires are installed in certain cases as an added safety factor. Cable routing is critical and, in some locations, cables must be dressed to exactly fit into channels and other recesses in order to prevent chafing of wires against structure and equipment. If additional protection against chafing is necessary, insulated tubing and strips may be used as follows:

MATERIAL		TEMPERATURE
Flexible plastic tubing (Surco)	Item 67, Materials List	Below 160°F
Semi-rigid amber tubing	Item 136, Materials List	Below 160°F
Cotton sleeving tubing	Item 68, Materials List	Below 160°F
Glass fiber sleeving tubing (silicone impregnated)	Item 68, Materials List	High temperature
Pressure-sensitive tape	Item 127, Materials List	High temperature
Glass tape	Item 127, Materials List	High temperature
Corprene tape	Item 125, Materials List	Low temperature
Vinyl tape	Item 129, Materials List	Low temperature

When repairing wiring, the original installation should be duplicated if possible. Excessive use of any of these materials should be avoided and, where tubing is split, it should be spot-tied with applicable cord such as linen cord (item 37, materials list) or nylon cord (item 123, materials list) for low temperature areas, or Varglass cord "46" (item 137, materials list) or glass tape (item 127, materials list) for high temperature areas. The cords are also applicable to spot-tie electrical cables without using insulated tubing. Temperature classification is also effective on hookup wire. The following types of wire are applicable for temperature areas as shown:

Specification MIL-W-5086	Below 160°F
Specification MIL-W-7139	160°F to 400°F
AF-32659	400°F to 750°F

REPAIR OF WIRING.

When it is necessary to repair or replace airplane electrical wiring, only standard wiring and approved hardware must be used. It is preferable to use wire fabricating tools from the manufacturer of the terminals being used. The applicable numbers of AN solderless-type terminals and the tools which are approved for the operation are shown in figures 8-13 and 8-14. Extreme care must be exercised in preparing wires for lugging so that the repair will be permanent and trouble-free.

Note

The following instructions should be closely adhered to:

- Duplicate the original installation as closely as possible.
- Always use the approved wire, terminal and tool.
- Be careful to avoid nicked or broken strands in the wire. Do not use a wire stripper whose cutting edges overlap when the tool is squeezed together.
- Always crimp terminals with flat sides parallel to eyelet.
- Never ream terminal holes to fit larger screws than intended. Reamed holes weaken the terminals and reduce contacting surface, causing heat.
- Install terminals so that bending is not required for clearance in tight places. A maximum of one 90-degree bend is allowable during the life of a terminal (sizes No. 10 and smaller; larger sizes must not be bent more than 30 degrees).
- Use only copper terminals with copper wire and aluminum terminals with aluminum wires. Failure to observe this precaution will result in corroded terminals and poor contact.
- Do not use steel hardware in a current path. If buffer hardware is necessary on terminals, always use unpainted aluminum washers or plated brass nuts.
- Always provide adequate wire identification numbers on new wires (no less than one number, 6 inches from each end).

FABRICATION OF JUMPER WIRES FOR TEST PROCEDURES.

The use of jumper wires, fabricated with pins and/or sockets from discarded plugs and receptacles in place of test probes or clamps, when trouble shooting circuits at an electrical disconnect, will prevent damage to the disconnects and ensure good electrical connections. In addition, personal safety against electrical shock will be increased. A set of jumper wires, one for each size plug and receptacle normally encountered while trouble shooting, may be fabricated so that they will be available when needed. Fabrication of jumper wires may be accomplished as follows:

a. Secure discarded plugs and receptacles of various sizes and salvage the pins and sockets.

b. Secure several lengths of wire of the proper gage for the circuit in which the jumper is to be used and the proper length to extend between the two desired points.

c. Strip and tin each end of the wires.

d. Select a pin and socket (two pins or two sockets when applicable) the same size as the plug and/or receptacles for which the jumper is to be used.

e. Insert a three-inch length of electrical insulation (item 67, materials list) on each end of the wires.

f. Solder pins and/or sockets to each end of the wires.

g. Slide electrical insulation in place over the pin and/or socket.

CONSUMABLE MATERIALS

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
37	Cord, Linen	MIL-C-2520		
46	Dichloromethane, Technical ("Methylene Chloride")	MIL-D-6998; Stock No. R51M950-10		
58	Glass Fiber, Cord	MIL-Y-1140		
67	Insulation, Electrical (Surco)	MIL-I-631		
68	Insulation Sleeving, Electrical, Flexible, Treated	MIL-I-3190		
91	Naphtha, Aliphatic	TT-N-95; Stock No. R52N450		
111	Sealing Compound, Pressure Cabin	MIL-S-7124		
114	Sealing Compound (Potting), Synthetic Rubber	MIL-S-8516		

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
117	Solder, Rosin Core	QQ-S-571		
120	Solvent, Safety — Mixture of the following Specification compounds:	MIL-S-18718 (Aer); Stock No. R-52-BUA-XAE-107-128		
	Dichloromethane, 25% Vol;	MIL-D-6998		
	Dry Cleaning Solvent, 70% Vol;	P-S-661		
	Perchloroethylene, 5% Vol	O-P-191; Stock No. G5810-270-9982		
123	Synthetic Fiber, Nylon Cord	MIL-C-572		
125	Tape, Adhesive, Rubber and Cork Composition	MIL-T-6841		
127	Tape, Glass Cloth, Pressure-sensitive, Flame-proof	MIL-P-4053		
129	Tape, Vinyl	No. 473	Minnesota Mining and Manufacturing Co.	
135	Trisodium Phosphate	O-S-642; Stock No. G6810-240-2115		
136	Tubing, Semi-rigid Amber	NA2-4172	North American Aviation, Inc.	
137	Varglass Cord	46		

TEST POINT TROUBLE SHOOTING.

To ease and expedite electrical maintenance, test point trouble shooting data has been incorporated in system trouble isolation procedures and system wiring diagrams. As any system failure or malfunction may result from any one or a combination of electrical, hydraulic, pneumatic or mechanical reasons, all probable causes (reasons) for a stated trouble are covered in the same trouble isolation chart. There are three types of test points: major, secondary and minor. Textual references to these test points are made within each system trouble shooting paragraph and the specific location of each test point may be determined by referring to the appropriate system wiring diagram in Section X. No test point designation will be duplicated nor will more than one test point designation be given to any test point.

MAJOR TEST POINTS.

Major test points are used to isolate a power system failure to a physical portion of the airplane or to a group of systems. Major test points are symbolized on system wiring diagrams by a star encircled Arabic numeral. Major test points are referred to in text as: test point 1, test point 2, etc. Some examples of major test points are: generator and inverter outputs, power distribution connections, etc.

SECONDARY TEST POINTS.

Secondary test points are used to isolate failure to a specific system or to a specific item within a system. Secondary test points are symbolized on system wiring diagrams by an encircled capital letter(s). The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Secondary test points are referred to in text as: test point A, test point AB, etc. Some examples of secondary test points are: power inputs to individual units, tie-ins with parallel or interrelated systems, sequence switches, etc. Secondary test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

MINOR TEST POINTS.

Minor test points are used to isolate failure within a unit. Minor test points are symbolized on system wiring diagrams by an encircled capital letter and Arabic numeral. The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Minor test points are referred to in text as: test point A1, test point A2, etc. Some examples of minor test points are: continuity through a switch or a relay that is part of a unit, resistance readings of items within a unit, etc. Minor test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

USE OF TROUBLE SHOOTING CHARTS.

The best trouble shooting aid is preventive maintenance and cleanliness. The next best trouble shooting aid is thorough knowledge of the theory and operation of the system in question. A thorough knowledge of the system permits rapid determination of the

most likely probable cause for any given trouble and thereby reduces trouble shooting time and effort. The third most important aid is safety; observe all safety rules, check to make sure that the airplane and any attached ground power equipment is properly grounded, check to make sure that all ground safeties are installed, follow the trouble shooting instructions and if it is a two-man job, get another man to help. What is the trouble? Check the squawks, observe or perform an operational or functional check of the system in question. Check the trouble shooting charts of the system for the determined trouble. Select the most probable cause(s) and proceed to isolate the trouble; set up the system as specified in the "System Conditions" portion of the chart. Use the appropriate meters. Do not make ohmmeter tests or continuity checks on an electrically "hot" airplane. Complete check-out of the system in question without correction of the trouble may indicate that a parallel or interrelated system is at fault. If so, refer to that system for appropriate trouble shooting information. When a remedy is performed that does not correct the trouble, select the next most probable cause and continue trouble shooting. Isolation procedures are set up to require a minimum of effort. Each procedure should either isolate the trouble itself or isolate the portion of the circuit that contains the trouble. When a test point procedure is called out for an item (for example, a valve solenoid), parts of that procedure not spelled out which may lead to isolating the fault are: visual inspection for signs of physical damage, check of the ground connection or bonding and a check for good electrical connections. Similarly, when test points are called out for relay terminals, the switch section of the relay involved should be checked for proper action and continuity. The various portions of the trouble shooting charts and their functions are as follows:

a. TEST EQUIPMENT. This portion of the charts contains a list of all test equipment that will be required to perform any isolation procedure that follows on the same chart.

b. SYSTEM CONDITIONS. This portion of the charts specifies the desired system conditions for the tests that will follow. Some isolation procedures may require a change to these conditions; if so, the new conditions will be given in note form.

c. TROUBLE. This is the observed symptom, malfunction, or fault.

d. PROBABLE CAUSE. The probable cause(s) states the condition or reason causing the trouble. Probable causes are listed in their most likely order. The probable causes may be electrical, mechanical, hydraulic, pneumatic, etc, or a combination of these reasons.

e. ISOLATION PROCEDURE. This portion of the charts is a positive statement of action. If the probable cause is nonelectrical, there will be no mention of test points; if electrical, specific directions related to one or more test points will be given. Isolation procedures are listed in their most likely or accessible order. What meter is to be used will be determined by the required meter reading(s). Use the appropriate system wiring diagram in Section X to locate test points and to perform wire segment continuity checks. Many isolation procedures require the use of test points located at a connector. In such cases, it is necessary to disengage the connector and to apply the test probe to the plug or receptacle portion of the connector as shown on the system wiring diagram. Connectors should never be disengaged with electrical power applied to the airplane. Do not damage connector sockets by inserting test probes.

f. METER READING. If the isolation procedure is nonelectrical, this portion of the chart will indicate that none is required. If test points have been specified in the isolation procedure, the value and type of reading will be stated. Resistance and voltage readings are the type most commonly required for the isolation procedures; values given will indicate their type and the corresponding type of meter should be used to obtain the reading.

g. REMEDY. For nonelectrical isolation procedures, the remedy will indicate the maintenance action required depending upon the results of the isolation procedure. For electrical isolation procedures, the remedy will indicate the maintenance action required for the meter reading obtained. Most remedies will indicate a definite maintenance action, but some remedies will indicate that further isolation procedures should be performed. Some meter readings will indicate that the airplane wiring is at fault (open or shorted) and the remedy will be to perform a wire segment continuity check. Such continuity checks should be performed so as to minimize effort. Remove power and disconnect wires as necessary; then, check for continuity at the most accessible mid point of the circuit; in this manner, several wire segments can be checked for continuity at one time.

WARNING

Never disconnect wires or disengage disconnects with electrical power applied to the airplane. Always ground the airplane and any attached ground power equipment.

Note Secondary test points are listed alphabetically and opposite to each applicable wiring diagram title. Figure numbers of the wiring diagrams listed can be found in the Wiring Diagram Index of Section X of this handbook. Major test points, not listed, can be found in the Starting and D-C Generating System, the D-C Power Distribution System and the A-C Power Supply and Distribution System wiring diagrams. Minor test points, also not listed, can be found by associating them with similar secondary tests points.

TEST POINT	WIRING DIAGRAM TITLE
A, AA-AZ, and AAA-AAZ	Gun Firing System
ABA-ABZ	Ammo Booster System
ACA-ACZ	Gun Pneumatic Compressor Control System (Gun charging)
ADA-ADZ	Aircraft Fire Control System, Mark 16 Mod 1
AFA-AFZ	Gun Firing System
AGA-AGZ	Gun Firing System (Gun bay purging)
ALA-ALZ	Exhaust Temperature Indicating System
AMA-AMZ, AMMA-AMMZ	Bullpup Missile System
APA-APZ	Gun Pneumatic Compressor Control System
ARA-ARZ	Bomb and Rocket System Permanent Provisions (Bombing System)
ASA-ASZ	Bomb and Rocket System Permanent Provisions (Rocket System)
ATA-ATB	Armament Packages (Bullpup Missile System)
AWA-AWZ AWAA-AWAZ	Bomb and Rocket System Permanent Provisions (Sidewinder System)
AXA-AXZ	Armament Packages
AUA-AUZ	Armament Packages (Sidewinder System)
AYA-AYZ	Bomb and Rocket System Permanent Provisions (Sidewinder System)
AZA-AZZ	Bomb and Rocket System Permanent Provisions (Bombing system)
BA-BZ	Gun Camera System
CAA-CAZ	Normal and Alternate Trim System (Aileron Trim)
CFA-CFZ	Wing Flap and Droop Leading Edge Actuators (Wing flap system)
CGA-CGZ	Wing Flap and Droop Leading Edge Actuators (Wing flap and droop leading edge indicating system)
CHA-CHZ, CHAA-CHAZ	Normal and Alternate Trim System (Horizontal stabilizer trim)
CLA-CLZ	Wing Flap and Droop Leading Edge Actuators (Droop leading edge system)
CPA-CPZ	Rudder Pedal Shaker System
CRA-CRZ	Normal and Alternate Trim System (Rudder trim)
CSA-CSZ	Speed Brakes and Position Indicator
CWA-CWZ	Flight Control Pressure Warning System
CYA-CYZ	Rudder Boost and Yaw Damper System
D, DA-DZ	Hydraulic Pressure Indicating System
DLA-DLZ	Oxygen System
EFA-EFZ	Fuel Flow Indicating System
ETA-ETZ	Engine Tachometer Indicator
EPA-EPZ	Oil Pressure Indicating System
EQA-EQZ	Fuel Quantity Indicating System
F, FA-FZ	Vertical Gyro System
FAA-FAZ	Angle-of-Attack and Angle-of-Sideslip Indicating System [1]
FCA-FCZ	Polar Path Compass System
FFA-FFZ	Inverter Failure Warning
FLA-FLZ	Approach Light System [1]
FMA-FMZ	Angle-of-Attack and Angle-of-Sideslip Indicating System [2]
FNA-FNZ	Approach Light System [2]
FPA-FPZ	Pitot Heater
FQA-FQZ	Counter-Pointer Altimeter [6]

[1] Airplanes 139531i through 1435931

[2] Airplanes 143594m and subsequent

[6] Airplanes having Service Change No. 517 complied with

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Figure No. 8-15. Locating Test Point Symbols (Sheet 1)

TEST POINT TROUBLE SHOOTING

8-12A. TEST POINT TROUBLE SHOOTING.

8-12B. To ease and expedite electrical maintenance, test point trouble shooting data has been incorporated in system trouble isolation procedures and system wiring diagrams. As any system failure or malfunction may result from any one or a combination of electrical, hydraulic, pneumatic or mechanical reasons, all probable causes (reasons) for a stated trouble are covered in the same trouble isolation chart. There are three types of test points: major, secondary and minor. Textual references to these test points are made within each system trouble shooting paragraph and the specific location of each test point may be determined by referring to the appropriate system wiring diagram in Section X. No test point designation will be duplicated nor will more than one test point designation be given to any test point.

8-12C. MAJOR TEST POINTS.

8-12D. Major test points are used to isolate a power system failure to a physical portion of the airplane or to a group of systems. Major test points are symbolized on system wiring diagrams by a star encircled Arabic numeral. Major test points are referred to in text as: test point 1, test point 2, etc. Some examples of major test points are: generator and inverter outputs, power distribution connections, etc.

8-12E. SECONDARY TEST POINTS.

8-12F. Secondary test points are used to isolate failure to a specific system or to a specific item within a system. Secondary test points are symbolized on system wiring diagrams by an encircled capital letter(s). The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Secondary test points are referred to in text as: test point A, test point AB, etc. Some examples of secondary test points are: power inputs to individual units, tie-ins with parallel or interrelated systems, sequence switches, etc. Secondary test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

8-12G. MINOR TEST POINTS.

8-12H. Minor test points are used to isolate failure within a unit. Minor test points are symbolized on system wiring diagrams by an encircled capital letter and Arabic numeral. The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Minor test points are referred to in text as: test point A1, test point A2, etc. Some examples of minor test points are: continuity through a switch or a relay that is part of a unit, resistance readings of items within a unit, etc. Minor test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

8-12J. USE OF TROUBLE SHOOTING CHARTS.

8-12K. The best trouble shooting aid is preventive maintenance and cleanliness. The next best trouble shooting aid is thorough knowledge of the theory and operation of the system in question. A thorough knowledge of the system permits rapid determination of the most likely probable cause for any given trouble and thereby reduces trouble shooting time and effort. The third most important aid is safety; observe all safety rules, check to make sure that the airplane and any attached ground power equipment is properly grounded, check to make sure that all ground safeties are installed, follow the trouble shooting instructions and if it is a two-man job, get another man to help. What is the trouble? Check the squawks, observe or perform an operational or functional check of the system in question. Check the trouble shooting charts of the system for the determined trouble. Select the most probable cause(s) and proceed to isolate the trouble; set up the system as specified in the "System Conditions" portion of the chart. Use the appropriate meters. Do not make ohmmeter tests or continuity checks on an electrically "hot" airplane. Complete check-out of the system in question without correction of the trouble may indicate that a parallel or interrelated system is at fault. If so, refer to that system for appropriate trouble shooting information. When a remedy is performed that does not correct the trouble, select the next most probable cause and continue trouble shooting. Isolation procedures are set up to require a minimum of effort. Each procedure should either isolate the trouble itself or isolate the portion of the circuit that contains the trouble. When a test point procedure is called out for an item (for example, a valve solenoid), parts of that procedure not spelled out which may lead to isolating the fault are: visual inspection for signs of physical damage, check of the ground connection or bonding and a check for good electrical connections. Similarly, when test points are called out for relay terminals, the switch section of the relay involved should be checked for proper action and continuity. The various portions of the trouble shooting charts and their functions are as follows:

a. TEST EQUIPMENT. This portion of the charts contains a list of all test equipment that will be required to perform any isolation procedure that follows on the same chart.

b. SYSTEMS CONDITIONS. This portion of the charts specifies the desired system conditions for the tests that will follow. Some isolation procedures may require a change to these conditions; if so, the new conditions will be given in note form.

c. TROUBLE. This is the observed symptom, malfunction, or fault.

d. PROBABLE CAUSE. The probable cause(s) states the condition or reason causing the trouble. Probable causes are listed in their most likely order. The probable causes may be electrical, mechanical, hydraulic, pneumatic, etc, or a combination of these reasons.

e. ISOLATION PROCEDURE. This portion of the charts is a positive statement of action. If the probable cause is nonelectrical, there will be no mention of test points; if electrical, specific directions related to one or more test points will be given. Isolation procedures are listed in their most likely or accessible order. What meter is to be used will be determined by the required meter reading(s). Use the appropriate system wiring diagram in Section X to locate test points and to perform wire segment continuity checks. Many isolation procedures require the use of test points located at a connector. In such cases, it is necessary to disengage the connector and to apply the test probe to the plug or receptacle portion of the connector as shown on the system wiring diagram. Connectors should never be disengaged with electrical power applied to the airplane. Do not damage connector sockets by inserting test probes.

f. METER READING. If the isolation procedure is nonelectrical, this portion of the chart will indicate that none is required. If test points have been specified in the isolation procedure, the value and type of reading will be stated. Resistance and voltage readings are the type most commonly required for the isolation procedures; values given will indicate their type and the corresponding type of meter should be used to obtain the reading.

g. REMEDY. For nonelectrical isolation procedures, the remedy will indicate the maintenance action required depending upon the results of the isolation procedure. For electrical isolation procedures, the remedy will indicate the maintenance action required for the meter reading obtained. Most remedies will indicate a definite maintenance action, but some remedies will indicate that further isolation procedures should be performed. Some meter readings will indicate that the airplane wiring is at fault (open or shorted) and the remedy will be to perform a wire segment continuity check. Such continuity checks should be performed so as to minimize effort. Remove power and disconnect wires as necessary; then, check for continuity at the most accessible mid point of the circuit; in this manner, several wire segments can be checked for continuity at one time.

WARNING

Never disconnect wires or disengage disconnects with electrical power applied to the airplane. Always ground the airplane and any attached ground power equipment.

TEST POINT	WIRING DIAGRAM TITLE
G, GA-GZ and GAA-GAZ	Landing Gear Sequencing System
GBA-GBZ	Landing Gear Warning and Indicating System
GCA-GCZ	Landing Gear Sequencing System (Landing gear emergency extension)
GDA-GDZ	Wing Fold System
GEA-GEZ	Arresting Hook System
HA-HZ and HAA-HAZ	Cockpit Air Conditioning, Defrost and Anti-ice System
HPA-HPZ	Cockpit Pressurization System
K, KA-KZ	Starting and D-C Generating System (Engine starting)
LAA-LAZ	Interior Lights - Instrument Lights and Cockpit Floodlights (Instrument lights)
LCA-LCZ	Interior Lights - Console Lights and Console Floodlights (Instrument and console refractor panel lights)
LEA-LEZ	Exterior Lights
LFA-LFZ	Interior Lights - Instrument Lights and Cockpit Floodlights (Floodlights)
LLA-LLZ	Landing Light
LWA-LWZ	Warning Light Dimming System
MAA-MAZ	Canopy Actuator
MBA-MBZ	Canopy Actuator (Canopy sealing)
MPA-MPZ	Pilot's Seat Actuator

TEST POINT	WIRING DIAGRAM TITLE
PA-PZ	Starting and D-C Generating System (D-C power supply)
PBA-PBZ	D-C Power Distribution System (RH forward console)
PCA-PCZ	D-C Power Distribution System (RH rear vertical console)
PDA-PDZ	D-C Power Distribution System (LH forward console)
PEA-PEZ	D-C Power Distribution System (LH rear console)
PFA-PFZ	D-C Power Distribution System (Pilot's instrument panel)
PGA-PGZ	D-C Power Distribution System (LH radio bay circuit-breaker panel)
PHA-PHZ	D-C Power Distribution System (Cover assembly for RH radio bay electrical junction box)
PJA-PJZ	D-C Power Distribution System (Top deck circuit-breaker panel)
PPA-PPZ	D-C Power Distribution System
PVA-PVZ	Starting and D-C Generating System (Overvoltage system)
PWA-PWZ	Starting and DC Generating System (Generator out warning light system)
QA-QZ	Fuel Transfer and Fuel and Defuel Control System
QBA-QBZ	Fuel Boost Pumps
QCA-QCZ	In-flight Refueling System
QFA-QFZ	Fuel Transfer and Fuel and Defuel Control System
QMA-QMZ	Manual Fuel Control
QRA-QRF	Refueling System - Dual Level Float Test [3]

[3] Airplanes 139531i through 141466j

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Figure No. 8-15. Locating Test Point Symbols (Sheet 2)

TEST POINT	WIRING DIAGRAM TITLE
QRG-QRN	Refueling System-Dual Level Float Test [4]
QRP-QRT	Refueling System-Dual Level Float Test [5]
QRU-QRZ and QSA-QSZ	Refueling System, Aft Fuselage Fuel Cell Level Control
QTA-QTZ	In-flight Refueling Tanker System
RCA-RCZ	UHF Command Set, AN/ARC-27A, and Automatic Direction Finder, AN/ARA-25
RNA-RNZ	Radio Receiving Set, AN/ARN-14E, and Radio Set, AN/ARN-21 (Radio set, AN/ARN-14E)
RTA-RTZ	Radio Receiving Set, AN/ARN-14E, and Radio Set, AN/ARN-21 (Radio set, AN/ARN-21)
SGA-SGZ	Radar Set, AN/APG-30A, Provisions
VA-VZ	A-C Power Supply Distribution System and (D-C power inputs)
WFA-WFZ	Fire Detector System
XA, XAA-XAZ	A-C Power Supply and Distribution System (Phase A circuits)
XB, XBA-XBZ	A-C Power Supply and Distribution System (Phase B circuits)
XC, XCA-XCZ	A-C Power Supply and Distribution System (Phase C circuits)
XNA-XNZ	A-C Power Supply and Distribution System (A-C ground circuits)
XV, XVA-XVZ	A-C Power Supply and Distribution System (26-volt single-phase circuits)

[4] Airplanes 141467j through 143542k

[5] Airplanes 1435431 and subsequent

FJ-4B-2-54-190

Figure No. 8-15. Locating Test Point Symbols (Sheet 3)

ELECTRICAL SYSTEMS

8-1. ELECTRICAL SYSTEMS.

8-2. Primary consideration is given in this section to the generating and distributing of electrical power which is utilized on the airplane under various operating conditions. However, in addition to components which have a solely electrical function, the airplane incorporates many components in which the main function is other than electrical, but the controlling or actuating agent is electrical power.

8-3. POWER SUPPLY SYSTEMS.

8-4. The electrical power supply systems furnish a-c and d-c potentials for all electrical components. Electrical potentials required are 27.7-volt d-c power; 200/115-volt a-c, 400-cycle, three-phase power; 115-volt a-c, 400-cycle, three-phase power and 26-volt a-c, 400-cycle, single-phase power. For details of the electrical power supply systems, refer to paragraphs 8-10 and 8-74.

8-5. POWER DISTRIBUTION SYSTEMS.

8-6. The electrical power distribution systems carry electrical power to the airplane's electrical loads by means of bus systems (points of common potential). Bus systems are individual distribution systems joined together by means of contactor or bus control relays in which heavy contacts permit the carrying of large electrical loads without excessive heating or voltage drop. For a complete description of the bus systems, refer to paragraphs 8-57 and 8-89.

8-7. PREVENTIVE MAINTENANCE.

8-8. A good preventive maintenance program is essential for dependable operation of the airplane's electrical system. Frequent visual inspections, periodic operational checks of electrical circuits and equipment and replacement or repair where necessary will eliminate most electrical troubles and hazards before serious troubles develop. The following list contains items which should be checked during these inspections:

a. Cleanliness of equipment and connections.
b. Damaged or overheated equipment
c. Damaged wiring, including insulation.
d. Damaged protective coverings on wiring and terminal strips.
e. Loose or damaged bonding devices.
f. Proper support of wiring and conduit.
g. Tightness of mechanical and soldered connections.
h. Continuity of fuses, circuit breakers and wiring.
i. Condition of lamps.
j. Clearance and insulation of exposed terminals.
k. Adequacy of safety wire, cotter pins, etc.
l. Physical alignment of electrically driven equipment.
m. Operational checks of electrically driven equipment.
n. Voltage checks with precision voltmeter.

8-9. CLEANING AND PRESERVATION. Cleanliness is of prime importance in the electrical system. Dirty electrical connections create a high resistance which lowers the voltage applied to electrical equipment and, also, creates a fire hazard due to heat generated at the connections. Motors and other electrical equipment may be damaged internally by dirt drawn into them. High frequency electrical equipment may malfunction due to current leakage paths through dirty terminal strips or plugs and receptacles. All parts of the electrical system should be kept clean at all times. Dust may be picked up with a portable vacuum cleaner. Fine emery cloth may be used to clean terminals and mating surfaces which have become corroded or dirty. Very fine sandpaper should be used to polish the commutator of motors and generators.

CAUTION

Do not use emery cloth on commutators.

D-C POWER SUPPLY SYSTEM

8-10. D-C POWER SUPPLY SYSTEM.

8-11. The d-c power supply system consists of three main equipment configurations: the battery system, the generator system and the external supply system. D-C power is furnished by the d-c power supply system to operate the airplane's electrical, electrically controlled and electronic systems. In addition, the d-c power supply system furnishes power to operate the airplane's two inverters. See figure 8-16 for location of electrical power supply components.

8-12. FUNCTION OF D-C POWER SUPPLY SYSTEM.

8-13. The three main d-c power supply configurations are designed to supply the airplane's electrical requirements under all phases of operation. Emergency operation of equipment necessary to maintain flight is furnished by the battery system. The battery can only supply power for short durations of time and is used exclusively as a source of emergency power. All flight and ground operation requirements are furnished by the generator system. The starter-generator is the source of all electrical power during normal operation and, in addition to supplying all d-c bus loads, the starter-generator furnishes power to operate the inverters which are the source of all a-c power. When starter-generator power is not available for ground operations, an external power unit connected into the 28-volt d-c external power receptacle functions as a direct substitute for the starter-generator. Starting, testing and servicing requirements are furnished by the external power supply system. For starting procedures, a 35-volt d-c external power supply can be applied to the airplane when connected into the external starting power receptacle. For testing and servicing power, a 28-volt d-c power supply is applied to the airplane through the 28-volt d-c external power receptacle. See figures 8-17 and 8-18 for schematic diagrams of the d-c power supply system.

8-14. TROUBLE SHOOTING D-C POWER SUPPLY SYSTEM.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: 27.7-volt d-c generator power applied.
D.C. POWER switch in "BAT. & GEN" position.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER; WARNING LIGHT ILLUMINATED.			
Brush failure.	Remove starter-generator (paragraph 5-86) and inspect brushes for proper seating and condition.		Replace or reseat brushes.
	Check commutator for pitted or scored condition.		Refinish commutator or replace starter-generator as required.
Defective starter-generator or power leads.	Check test point 1 to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace starter-generator or defective power leads.
Defective REVERSE CURRENT cutout or faulty starter-generator control circuit.	Check test points 2 and PD to ground.	28 volts dc.	No action.
		Zero volts at test point 2.	Replace REVERSE CURRENT cutout or trouble shoot starter-generator control circuit.
Starter-generator inner shaft broken.	Remove starter-generator and perform bench test.		Replace starter-generator.
Defective armature.	Remove starter-generator and check armature on test stand for shorts, grounds and opens.		Replace starter-generator.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER; WARNING LIGHT ILLUMINATED. (Cont)			
Defective wiring.*	Check test point PA and ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace wire to REVERSE CURRENT cutout.
Defective D.C. POWER switch and/or wiring.*	Check test point PB to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective D.C. POWER switch or wiring.
Defective STARTER SHUNT FIELD control relay and/or wiring.*	Check test point PC to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective STARTER SHUNT FIELD control relay or attached wiring.
Defective REVERSE CURRENT cutout and/or wiring.*	Check test point PD to ground.	28 volts dc.	Replace defective REVERSE CURRENT cutout.
		Zero volts.	Replace defective wire to STARTER SHUNT FIELD control relay.
Defective wiring.†	Check test point PA to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire to REVERSE CURRENT cutout.
Defective D.C. POWER switch and/or wiring.†	Check test point PH to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective D.C. POWER switch or wire to last previous test point.
Defective GEN. FIELD CONTROL RELAY and/or wiring.†	Check test point PB to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective GEN. FIELD CONTROL RELAY or defective wire between test points PH and PB.
Defective STARTER SHUNT FIELD control relay and/or wiring.†	Check test point PC to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace STARTER SHUNT FIELD control relay or attached wiring.
Defective REVERSE CURRENT cutout and/or wiring.†	Check test point PD to ground.	28 volts dc.	Replace defective REVERSE CURRENT cutout.
		Zero volts.	Replace defective wire to STARTER SHUNT FIELD control relay.

*Airplanes 139531i through 139555i
†Airplanes 141444j and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER; WARNING LIGHT ILLUMINATED. (Cont)			
Loss of residual magnetism.	**Note** Disconnect wire connected to test points PA and PE. Check test point 1 to ground.	2 to 4 volts dc.	No action.
		Less than 2 volts dc.	Flash starter-generator field.
Overvoltage condition due to defective or improperly adjusted voltage regulator resulting in actuation of overvoltage system.*	Using test points PJ, PK and PF, follow procedure in paragraph 8-47.	As specified in paragraph 8-47.	Replace or adjust voltage regulator.
		Results other than specified in paragraph 8-47.	Continue trouble shooting overvoltage system.
Defective GEN RESET switch or wiring.*	**Note** GEN RESET switch to be maintained in "GEN-RESET" position during this check. Check between test points PVB and PVC.	Infinite ohms.	Continue trouble shooting.
		Other than infinite ohms.	Replace defective GEN RESET switch.
	Note GEN RESET switch to be maintained in "GEN-RESET" position during this check. Check between test point PVA and ground.	24 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective GEN RESET switch, wire, or refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
Defective ANTI-CYCLING RELAY.*	Check between test point PVA and ground.	3 to 4 ohms.	Continue trouble shooting.
		Infinite ohms.	Refer to reset circuit trouble shooting in chart.
		140 ohms.	Replace defective ANTI-CYCLING RELAY.
Defective OVERVOLTAGE RELAY.*	**Note** ● Power to be removed from airplane for this check. ● Disconnect wire between test point PK of voltage regulator and test point PVG of OVERVOLTAGE RELAY at test point PK. Check between test point PVB and disconnected wire.	Infinite ohms.	Perform overvoltage system operational check as described in paragraph 8-47.
		Zero ohms.	Replace defective OVERVOLTAGE RELAY.

*Airplanes 141444j and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER; WARNING LIGHT ILLUMINATED. (Cont)			
Defective starter-generator field control circuit.*	**Note** Do not attempt to manually reset GEN. FIELD CONTROL RELAY. Place D.C. POWER switch in "OFF" position and check between test points PH and PD.	Zero ohms.	Perform wire segment continuity check between test points PJ and PVD.
		Infinite ohms.	Trouble shoot GENERATOR CONTROL RELAY reset circuit.
Defective GEN. FIELD CONTROL RELAY reset circuit.*	**Note** Remove aft section and engine in accordance with paragraphs 5-6 and 5-7 to facilitate further testing. Remove all power from airplane and check between test points PVA and PVE.	Zero ohms.	Perform bench test procedure of GEN. FIELD CONTROL RELAY as outlined in paragraph 8-49 and replace if defective.
		Infinite ohms.	Perform wire segment continuity check between test points PVA and PVE and replace or repair defective wire segment(s) as required.

TEST EQUIPMENT: Precision d-c voltmeter and ohmmeter.

SYSTEM CONDITIONS: Starter-generator power applied to airplane.
D.C. POWER switch in "BAT. & GEN" position.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
EXCESSIVE ELECTROLYTE APPARENT IN SUMP JAR OR HIGH RATE OF VACUUM TUBE FAILURE.*			
Defective or improperly adjusted voltage regulator and failure of overvoltage system.*	Check between test points PF and PG.	27.7 volts dc.	Refer to paragraph 8-23.
		Other than 27.7 volts dc.	Replace or adjust voltage regulator in accordance with paragraphs 8-43 and 8-44 and continue trouble shooting overvoltage system.
Defective GEN. FIELD CONTROL RELAY trip circuit.*	**Note** Remove aft section and engine in accordance with paragraphs 5-6 and 5-7 to facilitate further testing. Remove all power from airplane and check between test point PVB and ground.	7 to 8 ohms.	Continue trouble shooting.

*Airplanes 141444j and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
EXCESSIVE ELECTROLYTE APPARENT IN SUMP JAR OR HIGH RATE OF VACUUM TUBE FAILURE.* (Cont)			
Defective GEN. FIELD CONTROL RELAY trip circuit.* (Cont)	Remove all power from airplane and check between test point PVB and ground.	Other than 7 to 8 ohms.	Perform bench test procedure of GEN. FIELD CONTROL RELAY as outlined in paragraph 8-49 and replace if defective. Perform a wire segment continuity check between test points PVB and PVF, replacing or repairing defective wire(s) as required.
	Check between test points PVG and PK.	Zero ohms.	Continue trouble shooting.
		Infinite ohms.	Replace defective wire between test points PVG and PK.
	Check between test points PA and PVH.	Zero ohms.	Perform bench test procedure of OVERVOLTAGE RELAY as outlined in paragraph 8-50 and replace if defective.
		Infinite ohms.	Perform wire segment continuity check between test points PA and PVH and replace or repair defective wiring as required.

*Airplanes 141444j and subsequent

8-15. TROUBLE SHOOTING GROUNDED BUS. If a short circuit to ground is detected with all power loads disconnected, proceed as follows:

a. Look for a visual indication of power cable heating such as burned or scorched cables or smoke if cable was recently energized.

b. When trouble is found, disconnect feeder cable from stud or bus at the nearest point and check resistance to ground with an ohmmeter from both ends of the open circuit.

CAUTION

All power must be removed from the system for this check. Remove battery disconnect from battery. The ohmmeter will be damaged if it is applied across a source of voltage.

c. One side of the open circuit will show shorted and the other side will show open. Trace the shorted end and repeat the disconnecting and checking process as in steps a. and b. until shorted cable or equipment is found. Where wiring can be readily seen, a short circuit will be evident as burnt or discolored wiring, terminating at the short circuit.

8-16. TROUBLE SHOOTING OPEN BUS. The most common cause for an open bus is failure of the bus relay which connects the bus to its source of power. The bus relays are located on the top deck electrical relay panel. (See figure 8-16.) Proceed to check the defective circuit as follows:

a. Clip a large wire jumper across the power stud terminals of the applicable relay and re-check equipment on the malfunctioning bus. If the equipment now operates, the relay is defective and requires replacement.

b. If the malfunction persists and voltage is present at the bus contactor relay, proceed to check the distribution circuit, wire segment by wire segment, until the open section is found.

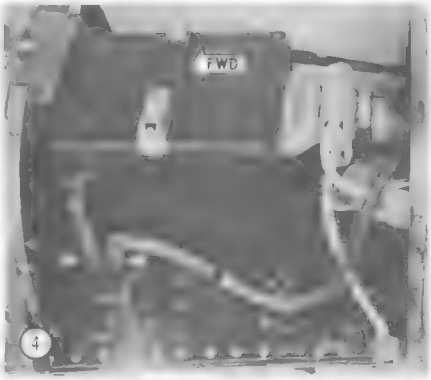
8-17. BATTERY SYSTEM.

8-18. The battery system is composed of the 24-volt battery and battery sump jar, the d-c power switch, the battery bus relay, the bus control relay and associated wiring. See figure 8-17 for schematic.

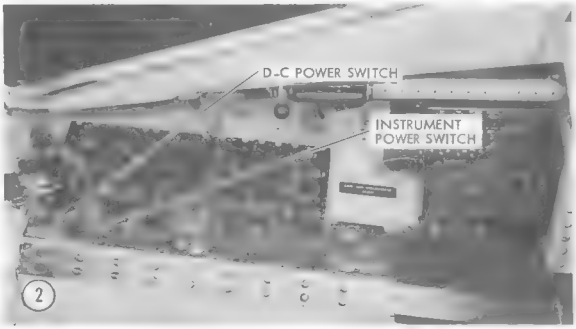
8-19. FUNCTION OF BATTERY SYSTEM.

8-20. The purpose of the battery system is to furnish 24-volt direct current potential for all units essential for flight in case of starter-generator failure. The battery is connected directly to the battery bus with a tie-in to the canopy and battery bus through the normally closed contacts of the canopy bus relay. D-C power to energize the battery bus relay is obtained from the canopy and battery bus when the D.C. POWER switch is in either "BAT. ONLY" or "BAT. & GEN" position. Energizing of the battery bus relay connects the battery bus to the primary bus, therefore permitting the battery bus to furnish d-c power to the primary bus. In case of starter-generator failure during flight with the landing gear

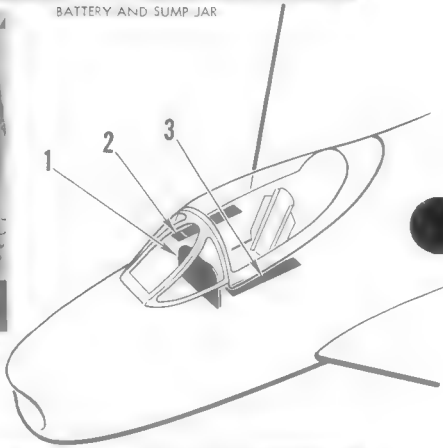
LEFT-HAND CONSOLE

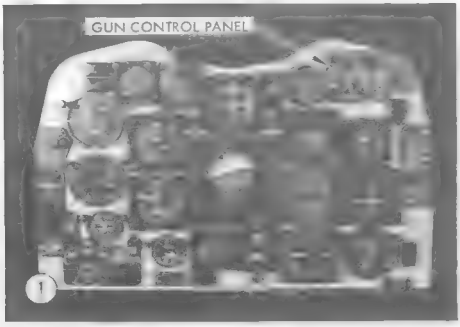


BATTERY AND SUMP JAR



RIGHT-HAND CONSOLE





INSTRUMENT PANEL

NO. 2 INVERTER AND YAW DAMPER UNIT

FJ-4B-2-54-28A

Figure No. 8-16. Electrical Power Supply Components (Sheet 1)

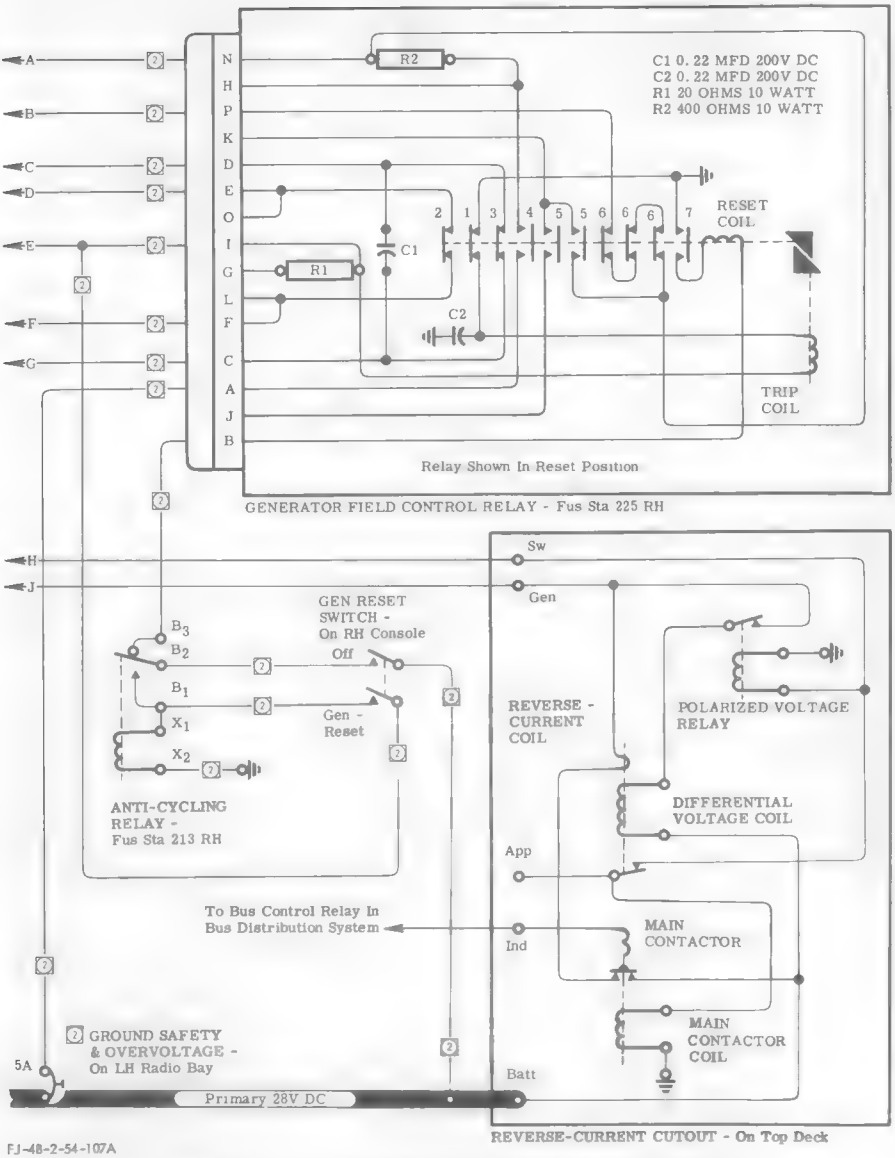


Figure No. 8-17. D-C Power System—Generator Power Applied (Sheet 2)

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER; WARNING LIGHT ILLUMINATED. (Cont)			
Loss of residual magnetism.	**Note** Disconnect wire connected to test points PA and PE. Check test point 1 to ground.	2 to 4 volts dc.	No action.
		Less than 2 volts dc.	Flash generator field.
Overvoltage condition due to defective or improperly adjusted voltage regulator resulting in actuation of overvoltage system.*	Using test points PJ, PK and PF, follow procedure in paragraph 8-50.	As specified in paragraph 8-50.	Replace or adjust voltage regulator.
		Results other than specified in paragraph 8-50.	Continue trouble shooting overvoltage system.
Defective GEN RESET switch or wiring.*	**Note** GEN RESET switch to be in deactuated position for this check. Check between test points PVB and PVC.	Infinite ohms.	Continue trouble shooting.
		Other than infinite ohms.	Replace defective GEN RESET switch.
	Note GEN RESET switch to be maintained in reset position during this check. Check between test point PVA and ground.	24 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective GEN RESET switch, wire, or refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.
Defective ANTI-CYCLING RELAY.*	Check between test point PVA and ground.	3 to 4 ohms.	Continue trouble shooting.
		Infinite ohms.	Refer to reset circuit trouble shooting in chart.
		140 ohms.	Replace defective ANTI-CYCLING RELAY.
Defective OVERVOLTAGE RELAY.*	**Note** ● Power to be removed from airplane for this check. ● Disconnect wire between test point PK of voltage regulator and test point PVG of OVERVOLTAGE RELAY at test point PK. Check between test point PVB and disconnected wire.	Infinite ohms.	Perform overvoltage system operational check as described in paragraph 8-50.
		Zero ohms.	Replace defective OVERVOLTAGE RELAY.

*Airplanes 141444 and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER; WARNING LIGHT ILLUMINATED. (Cont)			
Defective generator field control circuit.*	**Note** Do not attempt to manually reset GENERATOR FIELD CONTROL relay. Place d-c power switch in "OFF" position and check between test points PH and PD.	Zero ohms.	Perform wire segment continuity check between test points PJ and PVD.
		Infinite ohms.	Trouble shoot GENERATOR FIELD CONTROL relay reset circuit.
Defective GENERATOR FIELD CONTROL relay reset circuit.*	**Note** Remove aft section and engine in accordance with paragraphs 5-6 and 5-7 to facilitate further testing. Remove all power from airplane and check between test points PVA and PVE.	Zero ohms.	Perform bench test procedure of GENERATOR FIELD CONTROL relay as outlined in paragraph 8-51A and replace if defective.
		Infinite ohms.	Perform wire segment continuity check between test points PVA and PVE and replace or repair defective wire segment(s) as required.

TEST EQUIPMENT: Precision d-c voltmeter and ohmmeter.

SYSTEM CONDITIONS: Generator power applied to airplane.
D-C power switch in "BAT. & GEN" position.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
EXCESSIVE ELECTROLYTE APPARENT IN SUMP JAR OR HIGH RATE OF VACUUM TUBE FAILURE.*			
Defective or improperly adjusted voltage regulator and failure of overvoltage system.*	Check between test points PF and PG.	27.7 volts dc.	Refer to paragraph 8-26.
		Other than 27.7 volts dc.	Replace or adjust voltage regulator in accordance with paragraphs 8-46 and 8-47 and continue trouble shooting overvoltage system.
Defective generator field control trip circuit.*	**Note** Remove aft section and engine in accordance with paragraphs 5-6 and 5-7 to facilitate further testing. Remove all power from airplane and check between test point PVB and ground.	7 to 8 ohms.	Continue trouble shooting.

*Airplanes 141444j and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
EXCESSIVE ELECTROLYTE APPARENT IN SUMP JAR OR HIGH RATE OF VACUUM TUBE FAILURE.* (Cont)			
Defective generator field control trip circuit.* (Cont)	Remove all power from airplane and check between test point PVB and ground.	Other than 7 to 8 ohms.	Perform bench test procedure of GENERATOR FIELD CONTROL relay as outlined in paragraph 8-51A and replace if defective. Perform a wire segment continuity check between test points PVB and PVF, replacing or repairing defective wire(s) as required.
	Check between test points PVG and PK.	Zero ohms.	Continue trouble shooting.
		Infinite ohms.	Replace defective wire between test points PVG and PK.
	Check between test points PA and PVH.	Zero ohms.	Perform bench test procedure of OVERVOLTAGE RELAY as outlined in paragraph 8-52B and replace if defective.
		Infinite ohms.	Perform wire segment continuity check between test points PA and PVH and replace or repair defective wiring as required.

*Airplanes 141444j and subsequent

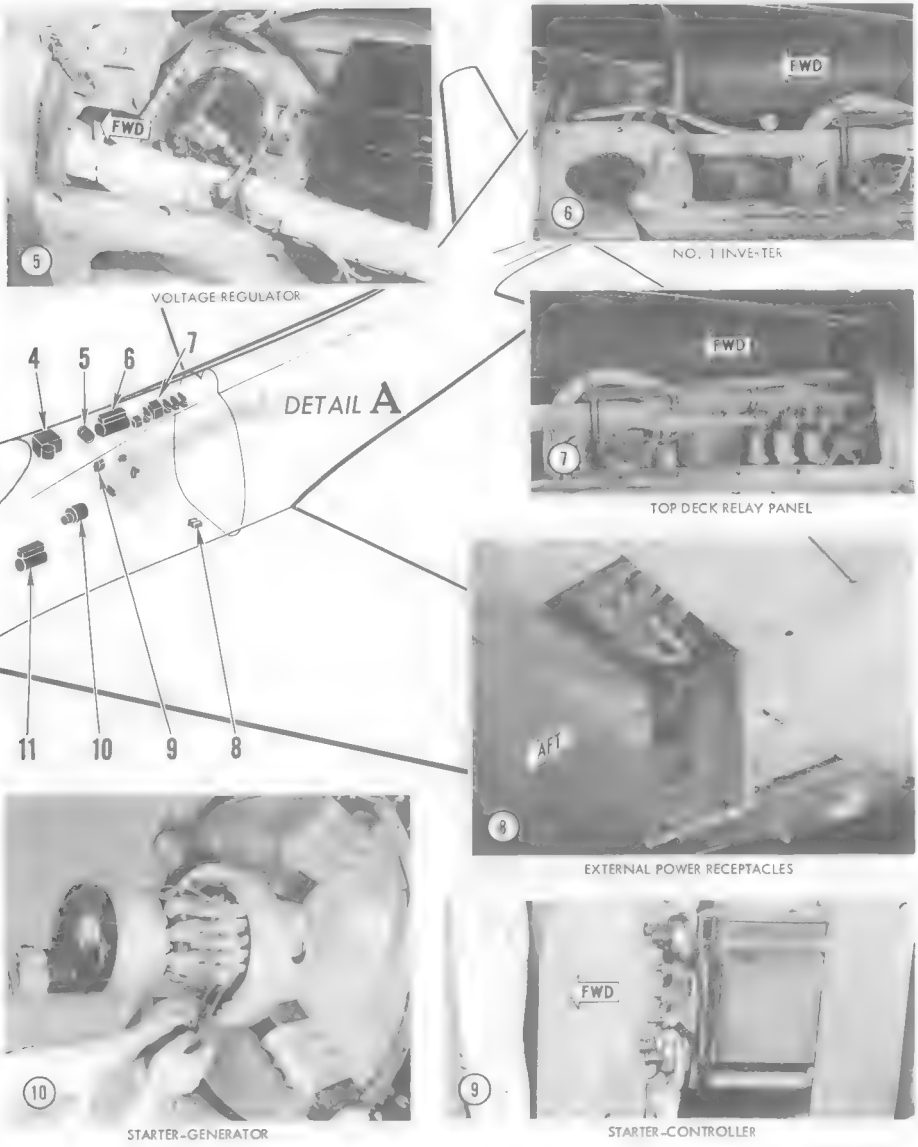


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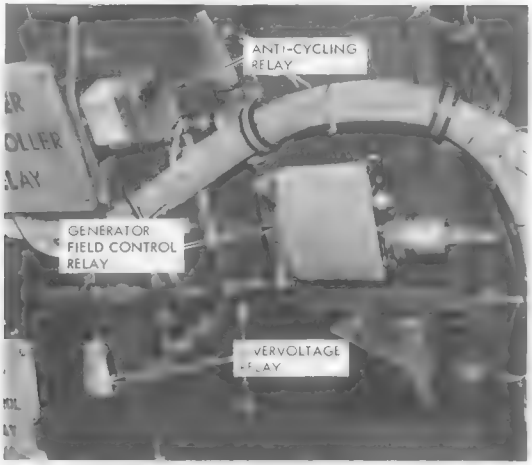
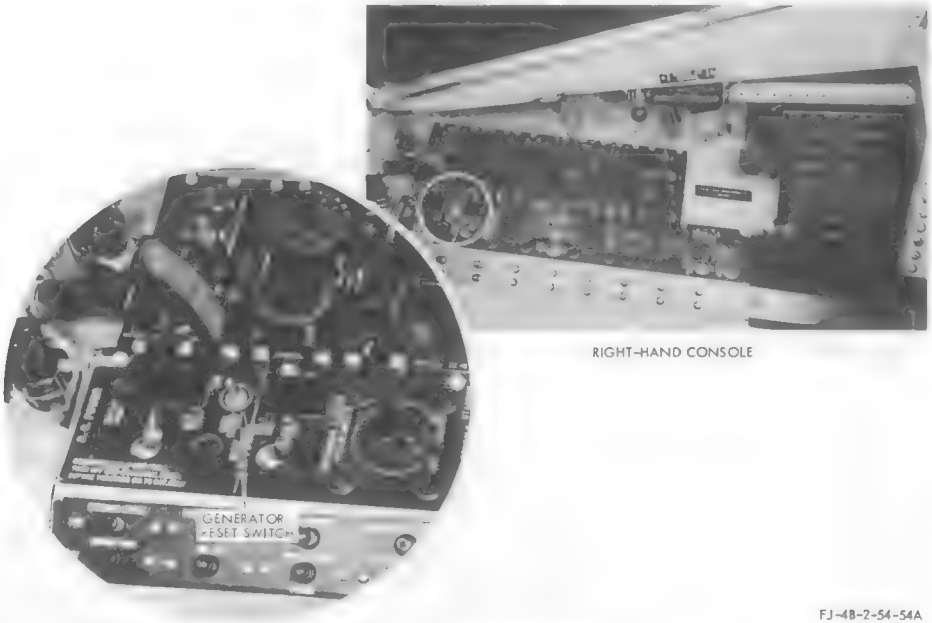
Figure No. 8-16. Electrical Power Supply Components (Sheet 2)



DETAIL A D-C OVERVOLTAGE PROTECTION SYSTEM
FJ-4j AIRPLANES AND SUBSEQUENT



RIGHT-HAND CONSOLE

FJ-4B-2-54-54A

Figure No. 8-16. Electrical Power Supply Components (Sheet 3)

handle in the "UP" position, the battery takes over the electrical loads on the primary bus and the secondary bus is disabled until the D.C. POWER switch is placed in the "BAT. ONLY" position. If the landing gear handle is in the "DOWN" position, the secondary bus is energized when the D.C. POWER switch is in either the "BAT. ONLY" or the "BAT. & GEN" position.

8-21. BATTERY.

8-22. The battery is a 24-volt, 24 ampere-hour, lead-acid type storage battery located on the top deck immediately aft of the cockpit. Battery power is limited and must be used exclusively as a source of emergency power. A vent system is incorporated for venting off excessive electrolyte and electrolytic gases. All connections to the battery are of the quick-disconnect type.

8-23. MAINTENANCE OF BATTERY. The battery should be inspected daily to ensure its usable condition at all times. Daily inspections require specific gravity measurements and visual inspection for any abnormal conditions. Remove the battery from the airplane and replace with a fully charged battery if any of the following conditions occur:

a. Specific gravity is below 1.240 after temperature correction. For temperature correction information, see figure 8-5.

CAUTION

An undercharged battery can cause damage to other electrical components. Keep the battery fully charged at all times.

b. Electrolyte level is too low to obtain specific gravity reading.

c. An accumulation of electrolyte is found above cell covers.

d. Corrosion is present on battery terminals or inside battery container.

e. The sump jar contains an excessive amount of electrolyte.

CAUTION

If an excessive amount of electrolyte is present in the battery sump jar, a high charging rate is indicated and the cause should be investigated and corrected if necessary. Check the voltage regulator setting and stability. (Refer to paragraph 8-43.)

The specific gravity of the electrolyte in the individual cells may be checked without removing the battery from the airplane by observing the following procedures:

a. Remove battery cover and individual cell vent plugs, one at a time.

b. Insert hydrometer hose into cell.

c. Withdraw enough electrolyte to allow float to be free when hydrometer is placed in a vertical position.

CAUTION

Pinch the end of the hydrometer hose to prevent electrolyte from dripping when the hydrometer is being withdrawn.

d. Read specific gravity and apply temperature correction.

e. Return electrolyte to cell from which it was withdrawn.

f. Replace individual cell vent plugs and battery covers.

g. Make certain that the battery sump jar is in proper condition. (Refer to paragraph 8-25.)

The electrolyte level in the individual cells may be checked by removing the battery cover and vent plugs. If the electrolyte level is low, add distilled water until the level of the electrolyte is $\frac{3}{8}$ inch above the top of the plates.

Notes

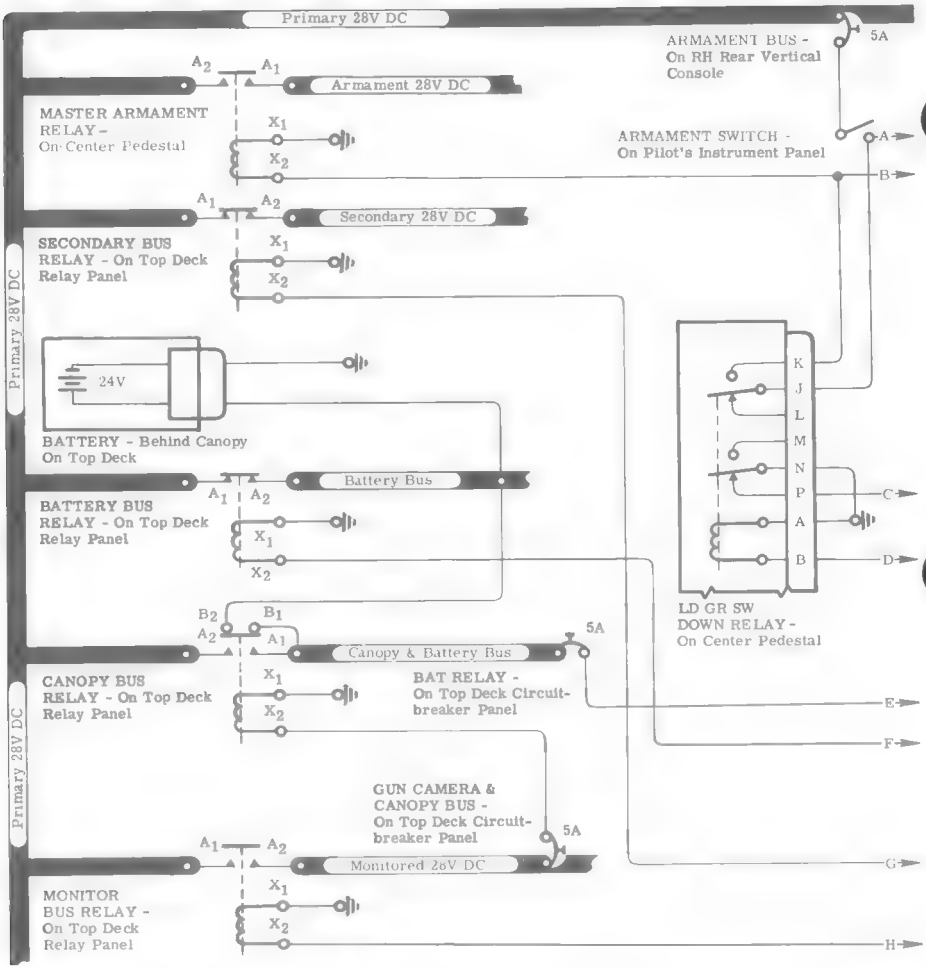
- It is advisable to wear rubber gloves when servicing battery to prevent acid burns on the skin.
- Do not overfill battery since too much water will cause leaks through the vents when airplane is in operation.
- Do not add water when the temperature is below freezing, unless battery is to be charged immediately.

When operated in extremely cold temperatures [below −18°C (0°F)], the battery should be maintained at full charge at all times to prevent freezing of electrolyte and to assure dependable operation. The battery should be kept above 0°C (32°F) because of its greatly decreased efficiency when used at low temperatures. Batteries should be removed from idle airplanes during cold weather and stored in a warm place. If removal is impractical, sufficient heat should be supplied to the battery compartment to maintain above freezing temperatures. External power sources should be used for testing purposes to conserve the battery. The battery should be maintained in a clean condition at all times. Corrosion and spilled electrolyte can be removed with a solution of sodium bicarbonate and water.

CAUTION

Do not allow the sodium bicarbonate and water solution to enter the cells.

A thin layer of petroleum jelly spread over the battery terminals will help prevent the formation of corrosion. All electrical and mechanical connections should be inspected frequently for tightness. After approximately 60 hours of operation, the battery should be sent to the local battery shop for complete servicing.

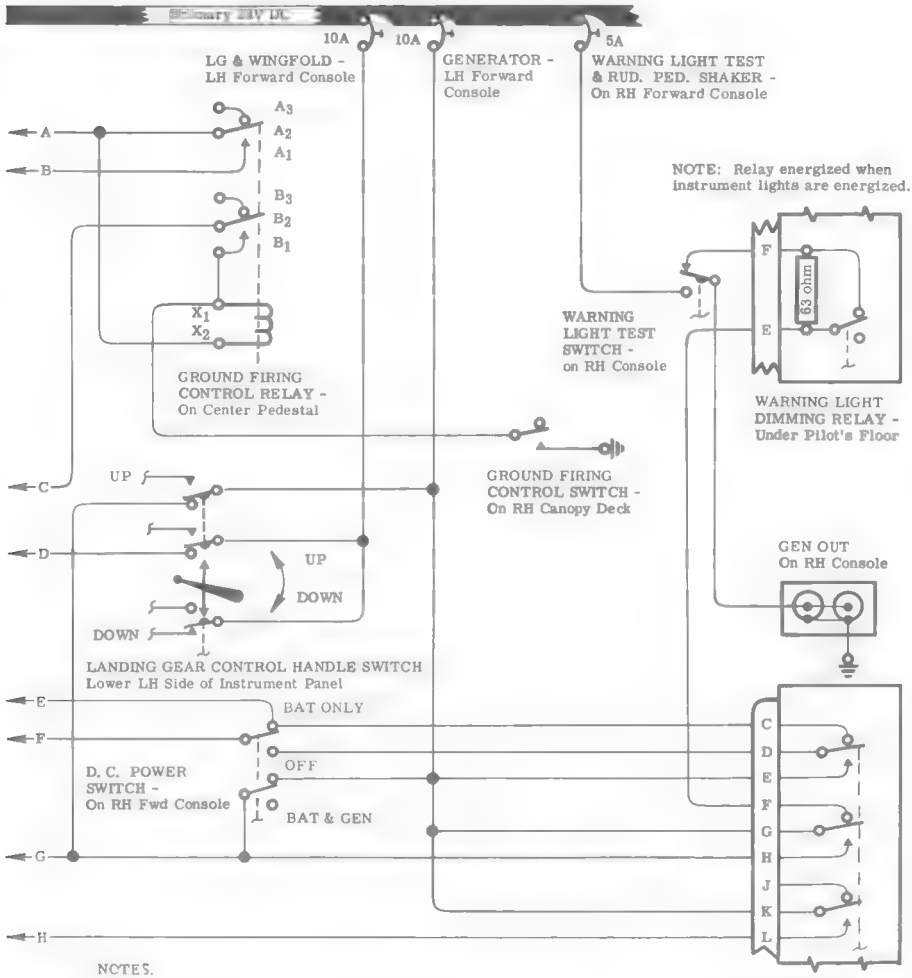


NOTES:

- Schematic presently shows airplane in "on deck" configuration with d-c power switch in "BAT ONLY" position.
- Circuit conditions for generator failure in flight would show landing gear control handle "UP," LD GR SW DOWN relay de-energized, d-c power switch in "BAT & GEN" position, and secondary bus disabled. Other circuitry remains unchanged.

FJ-4B-2-54-29A

Figure No. 8-17. D-C Power System—Battery Power Applied (Sheet 1)

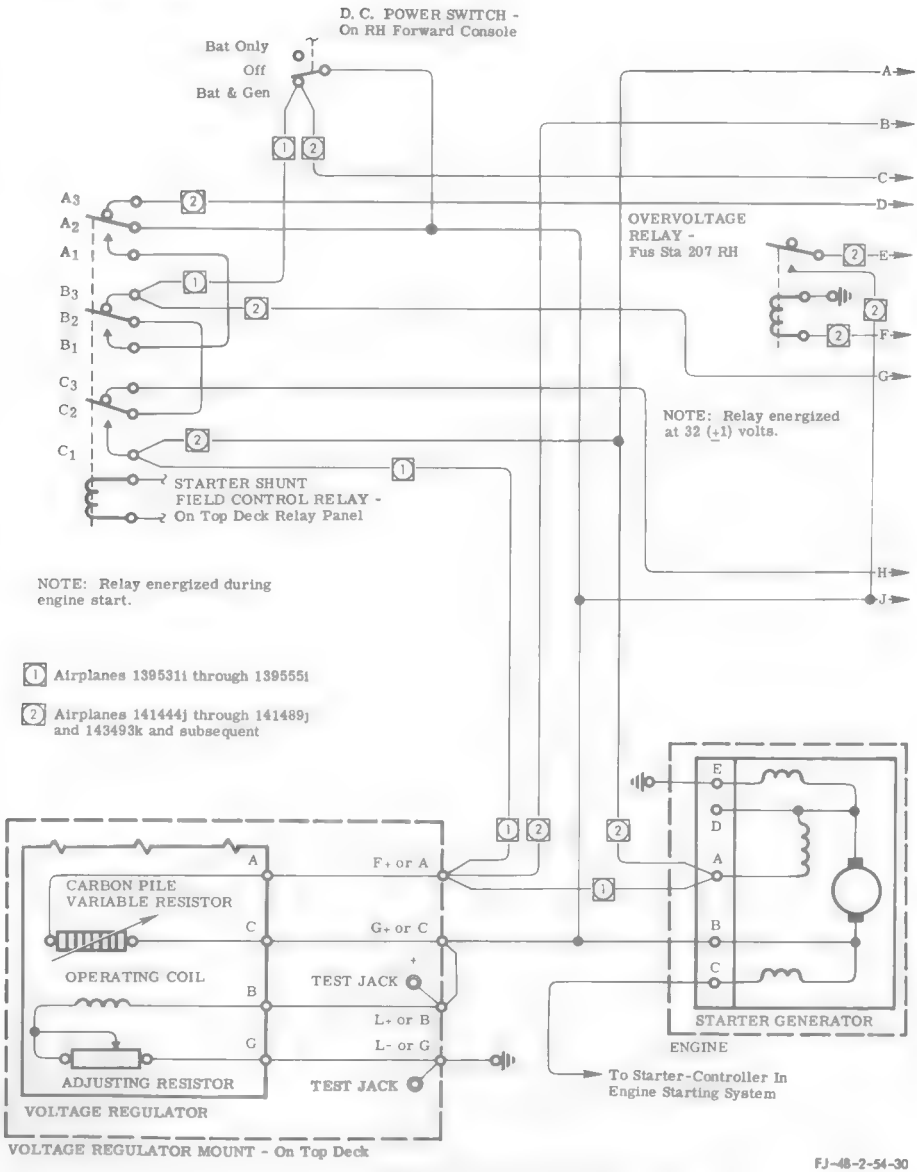


NOTES.

- In the event that secondary bus power is required with generator failure in flight, d-c power switch must be placed in "BAT. ONLY" position.
- With d-c power switch "OFF," only the "battery" and "canopy and battery" busses are energized, and the GEN OUT light will not illuminate.

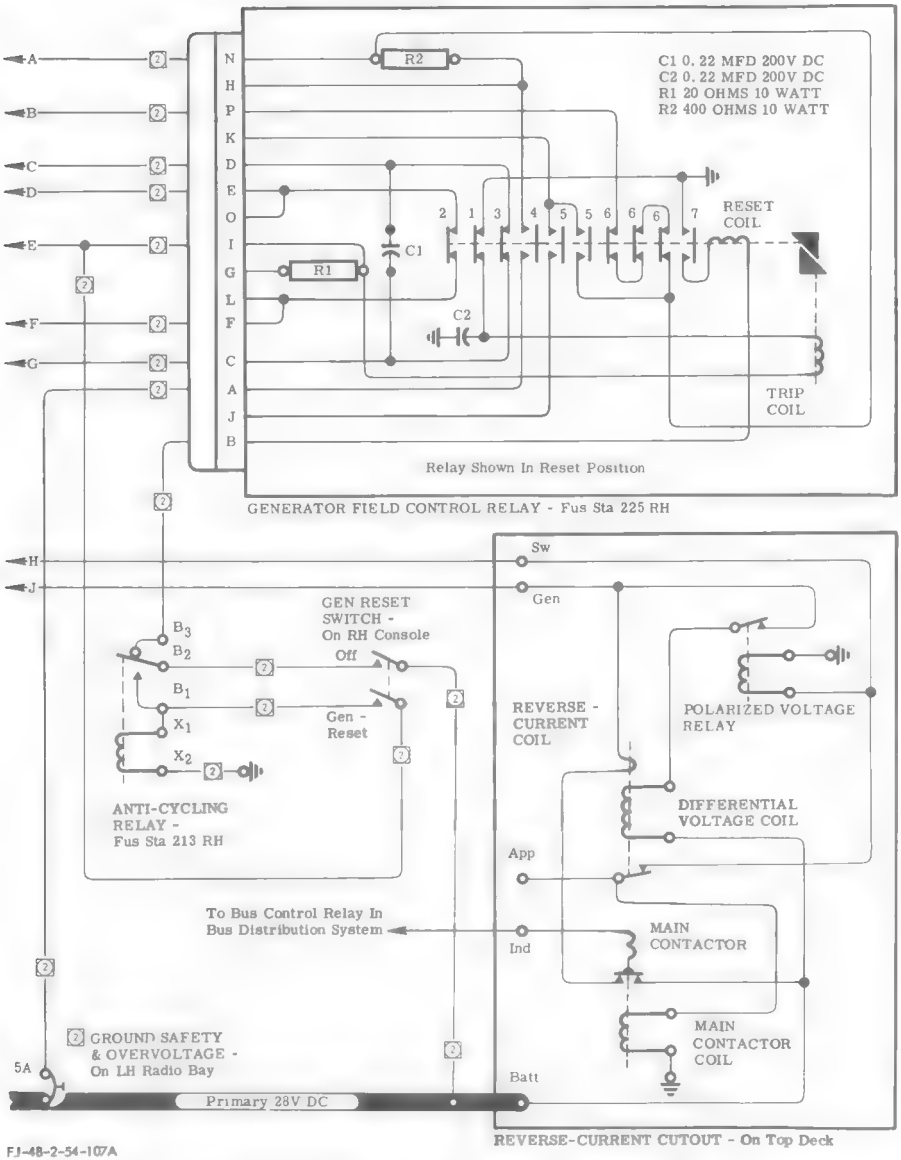
FJ-48-2-54-110A

Figure No. 8-17. D-C Power System—Battery Power Applied (Sheet 2)



FJ-48-2-54-30

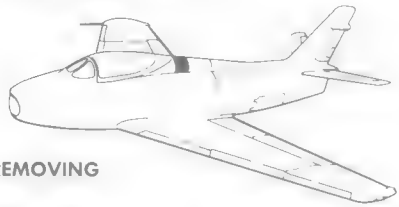
Figure No. 8-18. D-C Power System—Generator Power Applied (Sheet 1)



FJ-48-2-54-107A

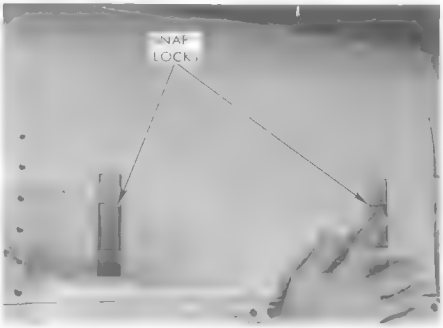
Figure No. 8-18. D-C Power System—Generator Power Applied (Sheet 2)

8-24. REMOVING AND INSTALLING BATTERY AND BATTERY SUMP JAR.



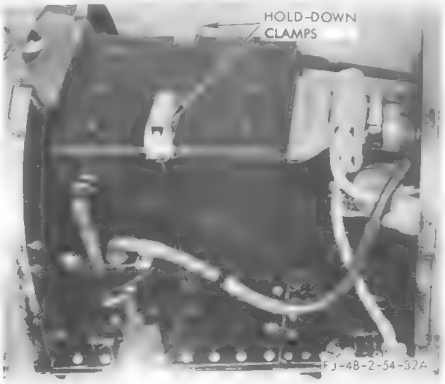
REMOVING

1 Unlock four snap locks on battery access cover and remove cover.

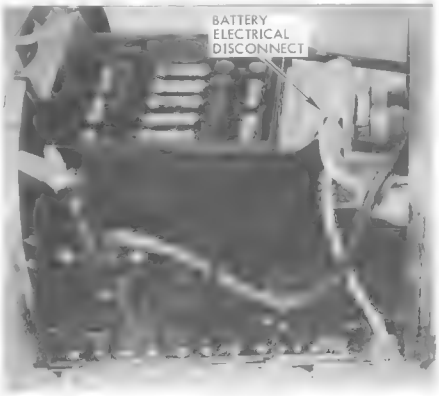


Caution Make certain that no electrical power is applied to airplane.

2 Remove safety wire from battery hold-down clamps and remove battery lid by releasing clamps.



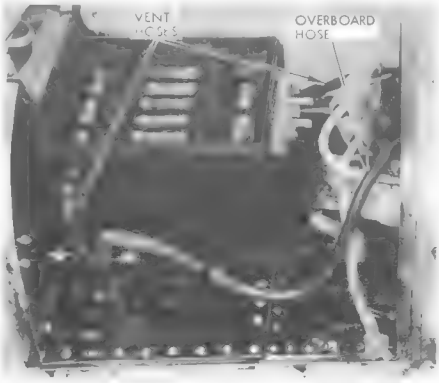
3 Twist battery electrical disconnect counterclockwise and remove from battery.



4 Pull vent hoses loose on left- and right-hand sides of battery.

5 For ease of removing battery, personnel should remove sump jar and bracket prior to removing battery from airplane.

6 To remove sump jar, disconnect overboard drain hose, loosen four wing fasteners on sump jar bracket and lift sump jar from airplane.



FJ-4B-2-54-92A

7 To remove sump jar from bracket, remove safety wire and two wing nuts on sump jar cover and remove cover.

8 Separate sump jar from bracket.

INSTALLING

Note Make certain that battery case vent ports are unobstructed before installing battery.

1 Clear battery area of vent hoses and battery disconnect.

2 Lift battery into position between hold-down clamps; replace lid and secure clamps. Use safety wire to secure clamps.

Caution Be careful not to tilt battery when installing. Tilting causes all vent caps to fill with electrolyte.

3 Install battery disconnect and twist clockwise to lock.

4 If sump jar was removed from bracket, install sump jar in bracket and fasten sump jar cover down with two wing nuts, securing wing nuts with safety wire.

5 Install vent hoses (one on each side of battery and from overboard drain to sump jar). Push nipples firmly into place and check for good friction fit.

Caution Care must be taken to have battery vent hoses properly connected and without twists or kinks. Otherwise, malfunction of venting system and subsequent failure of battery will occur.

6 Install access cover and secure with four snap locks.

Caution When replacing battery access cover make sure that all four snap locks are locked.

FJ-48-2-54-80A

8-25. BATTERY SUMP JAR.

8-26. The battery sump jar is located adjacent to the battery and is provided to neutralize any acid overflow from the battery. The sump jar installation consists of a glass jar, a jar cover assembly and seal, a metal or glass fabric jar container with bracket and vent lines. A sponge inside the glass jar is kept saturated with a solution of trisodium phosphate (item 135, materials list) which reacts chemically with any acid overflow from the battery. The battery sump jar cover assembly and seal prevents escape of acid and gases from the jar and also secures the jar inside the container by two wing nuts. The jar container is secured to the airplane structure by a bracket with four dzus-type fasteners. For details of battery sump jar installation, refer to paragraph 8-24.

8-27. MAINTENANCE OF BATTERY SUMP JAR. The battery sump jar installation should be inspected weekly to ensure effective operation. During these inspections, perform the following checks:

a. Check vent lines for restrictions.

b. Check sump jar cover for deterioration and replace if necessary.

c. Remove any liquid in glass jar.

d. Inspect sponge for dryness.

e. Moisten a piece of blue litmus paper and bring it in contact with the sponge.

If the sponge is dry, or if the blue litmus paper turns red, the sponge should be reactivated. To reactivate sponge, proceed as follows:

a. Remove sponge from jar.

b. Wash sponge thoroughly and allow to dry.

c. Prepare a saturated solution of boiling water and trisodium phosphate (item 135, materials list).

d. Dip sponge into solution and allow sponge to become saturated.

e. Allow sponge to cool and insert in jar.

f. Assemble battery sump jar and install in airplane.

g. Make sure vent hoses are not crimped after installation of sump jar.

8-28. GENERATOR SYSTEM.

8-29. The generator system consists of a dual-purpose starter-generator, a carbon-pile voltage regulator, a generator field control relay, a reverse-current cutout, a generator-out warning light, a bus control relay and a d-c power switch. Airplanes 141444j and subsequent incorporate an overvoltage protection system consisting of three additional relays and a generator reset switch. For further details, refer to paragraph 8-45 and see figure 8-18.

8-30. FUNCTION OF GENERATOR SYSTEM.

8-31. The starter-generator, operating as an engine-driven generator, supplies power to the primary bus through the reverse-current cutout. The primary bus is connected through bus tie-in relays to the other d-c busses in the airplane. The reverse-current cutout connects the starter-generator to the primary bus when the

generator voltage exceeds the bus voltage by 0.4 volts. When the primary bus is discharging 26 to 30 amperes into the starter-generator, the reverse-current cutout disconnects the starter-generator from the primary bus. The bus control relay becomes de-energized when the starter-generator is not connected to the primary bus and contacts in the bus control relay complete a circuit to the generator-out (GEN OUT) warning light. Illumination of the GEN OUT warning light indicates that the generator voltage is not high enough to cause the reverse-current cutout to close. Under normal starter-generator operation, the bus control relay is energized and the circuit to the GEN OUT warning light is broken. The voltage regulator is connected into the shunt field circuit of the starter-generator and maintains generator output voltage at 27.7 volts. When starting the engine, contacts in the starter shunt field control relay short out the voltage regulator. The d-c power switch controls the power supply to the primary bus. With the D.C. POWER switch in the "BAT. & GEN" position, the primary bus is powered from the starter-generator and supplies power to the battery bus. Placing the D.C. POWER switch in the "BAT. ONLY" position de-energizes the reverse-current cutout and disconnects the starter-generator from the primary bus. Under this condition, the primary bus is powered from the airplane's battery through the contacts of the battery bus relay. On airplanes 141444j and subsequent, the overvoltage protection system senses high generator voltage and opens the starter-generator shunt field circuit which removes the d-c field excitation and subsequently disables the starter-generator. Once the starter-generator has been disabled by the overvoltage protection system and has become disconnected from the distribution busses, the GEN RESET switch must be toggled to the "GEN-RESET" position before generator output can be obtained and connected to the busses. For further information, refer to paragraph 8-45.

8-32. STARTER-GENERATOR.

8-33. The starter-generator is located on the front end of the engine, inside the starter-generator cover. The starter-generator is geared directly to the engine and rotates at the same speed as the engine. When the engine is operating at 36% rpm or above, the generator will deliver full output voltage at full load conditions.

8-34. REMOVING AND INSTALLING STARTER-GENERATOR. Refer to paragraph 5-86 for instructions on removing and installing starter-generator.

8-35. REVERSE-CURRENT CUTOUT.

8-36. The reverse-current cutout is a unit which is employed in the generator system to connect the starter-generator to the primary bus when the starter-generator's output is sufficient to supply the airplane's electrical load. The cutout also disconnects the starter-generator from the primary bus when the starter-generator's output voltage falls below the battery voltage. The purpose of this provision is to prevent the starter-generator from draining battery current under engine seizure or starter-generator failure conditions. The reverse-current cutout is located on the top deck electrical relay panel. (See figure 8-16.) Internal wiring of the reverse-current cutout is shown in figure 8-18.

8-37. FUNCTION OF REVERSE-CURRENT CUTOUT.

8-38. The reverse-current cutout includes a differential relay, which is made up of a differential voltage coil and a reverse-current coil, a polarized voltage relay and the main contactor relay. These relays are constructed and interconnected in such a way that the main contactor does not close until the generator voltage is approximately 0.4 volt higher than the primary bus voltage. When the main contactor closes, the GEN OUT warning light goes out, indicating that the starter-generator is furnishing power to the primary bus. In the event of a starter-generator failure, or during normal engine shutdown procedure, current will flow from the primary bus into the generator. When this current reaches a value of 26 to 30 amperes, the reverse-current coil causes the contacts of the differential relay to open, breaking the circuit to the main contactor coil. De-energizing the main contactor coil opens the contacts of the main contactor and disconnects the starter-generator from the primary bus.

8-39. RESEALING REVERSE-CURRENT CUTOUT. The reverse-current cutout is sealed with sealing compound (item 111, materials list) to prevent entry of water and moisture. If the top plate is removed for any reason, it should be resealed by the following method:

a. Remove old sealing compound.

b. Apply new sealing compound around terminals "APP," "GEN," "BAT," "SW" and "IND."

CAUTION

Before applying sealing compound to a reverse-current cutout, make certain that the large terminals have center drilled holes for breathing. Do not seal a relay which does not have these ventilated terminals.

c. Install top plate and apply sealing compound in the five mounting holes and hole marked "T."

d. Install name plate and five mounting screws before compound hardens.

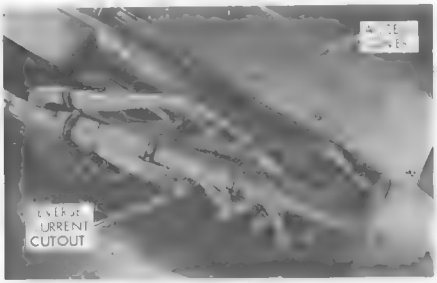
8-55. CARE OF EXTERNAL POWER RECEPTACLES. Careful insertion and removal of the external power plugs is essential to prevent frequent maintenance and replacement of receptacles. The construction of the external power receptacles and of the associated busses prohibits excessive twisting between the plug and receptacles where permanent service is required. The use of a minimum of side motion and more push and pull during insertion and removal of the plug is important in reducing looseness in the receptacle and associated busses. When looseness occurs, access to torqued nuts is best accomplished by first loosening the entire receptacle mounting bracket from the wing tie rods before attempting to remove the plastic cover assembly. Torquing of bus nuts should be in accordance with proper torque values for electrical studs. (Refer to the General Information paragraphs of Section VIII.) When receptacle pins become pitted or dirty, but remain tight, a fine grade of crocus cloth may be used to burnish the affected surfaces. Coarse emery cloth or other abrasives must never be used for this purpose.

8-40. REMOVING AND INSTALLING REVERSE-CURRENT CUTOUT.

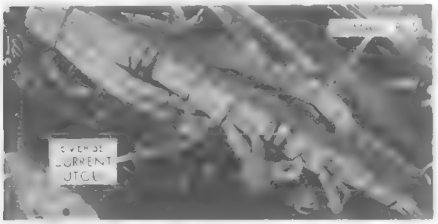
REMOVING

Caution Make certain that external power is removed from the airplane and remove the battery disconnect from the battery. Removing reverse-current cutout requires the handling of wires from all d-c busses.

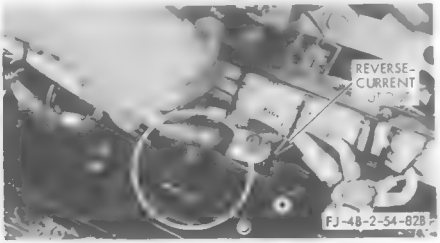
1 Gain access to top deck relay panel by loosening Camloc fasteners on hinged access cover and positioning cover to full open. For instructions on handling Camloc fasteners, refer to General Information, Section VIII.



2 Remove nuts from all studs on reverse-current cutout and those studs which connect primary bus to other relays.



3 Remove four mounting screws which fasten reverse-current cutout to panel.



4 Remove wires and cables from reverse-current cutout studs, being careful to either record wire connections or tag wires.

Warning A wrong electrical connection in this area can endanger the pilot and airplane without being detected on the ground.

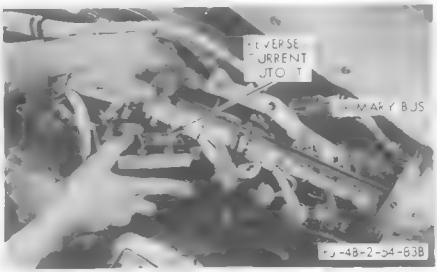
5 Spring bus from "BAT" terminal on reverse-current cutout to canopy bus relay just enough to allow free end to disengage from "BAT" terminal.

6 Lift heavy wire bundle over reverse-current cutout just enough to allow reverse-current cutout to be removed by slight maneuvering and tilting. Use care when pulling cutout off panel to prevent cutout studs from chafing or damaging wires.

Caution Do not attempt to connect electrical power of any kind to the airplane as long as the reverse-current cutout is removed.

INSTALLING

1 Insert reverse-current cutout, "SW" terminal first, under large wire bundle, lifting wire bundle slightly as unit is maneuvered into position on panel.

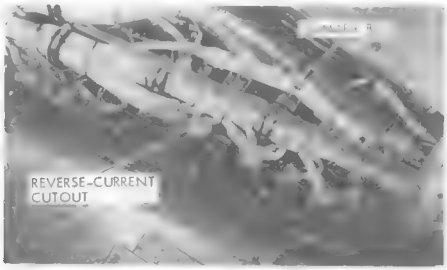


2 Using wire diagram on tags, install all wires on terminals except "BAT" cables and primary bus.

3 Secure reverse-current cutout to relay panel with four screws.

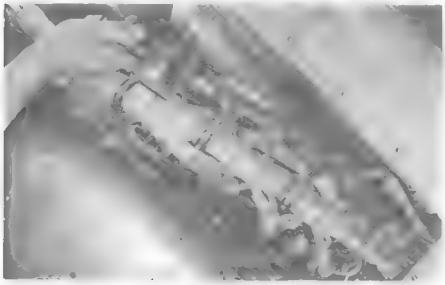
4 Install small bus from canopy bus relay onto "BAT" terminal and tighten bus terminal on canopy bus relay.

5 Install primary bus on terminals from which it was removed and install hardware on terminals.



Caution When installing hardware on large terminals, make certain that all hardware is on each terminal before tightening nut. Absence of lock washers will cause nuts to loosen and may cause electrical system failure.

6 Torque all large nuts to proper value as shown in figure 8-7. Do not torque half nuts to full torque limits. Close and secure access cover.



7 Perform operation check of d-c power system. (Refer to paragraph 8-33.) If any portion of system fails to perform normally, discontinue check immediately and check for incorrect wiring of reverse-current cutout.

FJ-48-2-54-1508

8-41. VOLTAGE REGULATOR.

8-42. A carbon pile voltage regulator is located in the top deck electrical compartment, forward of the No. 1 inverter. The voltage regulator, which controls the amount of resistance inserted into the shunt field circuit of the starter-generator, automatically maintains 27.7 (±0.3) volts in the d-c electrical system, regardless of the variations of starter-generator speed and the conditions of varying electrical load.

8-43. ADJUSTING VOLTAGE REGULATOR. Proper adjustment of the voltage regulator must be made when the voltage regulator has been allowed to reach a proper operating temperature (minimum 30 minutes) during engine run-up. Adjust the voltage regulator in the following manner:

a. Move voltage regulator rheostat to extreme counterclockwise position. (See figure 8-19.)

b. Insert positive lead of a precision voltmeter into the red test jack on the voltage regulator and insert negative lead into the black test jack.

Note

Precision voltmeters retained for checking aircraft instruments and aircraft electrical system voltage must be checked against an instrument of known accuracy every 90 days, or less if the voltmeter has been subject to abuse.

c. Place D.C. POWER switch in the "BAT. & GEN" position.

d. Start engine. (Refer to paragraph 1-9.)

FJ-48-2-54-34

Figure No. 8-19. Adjusting Voltage Regulator

e. Operate engine between 85 and 90% rpm.

WARNING

Avoid prolonged ground engine speeds between 60 and 82% rpm.

Note

Because of heavy consumption of fuel while engine is operating on the ground, a close generator voltage regulator adjustment should be made on the deck prior to a short flight, and a fine adjustment should be made when the airplane returns to the deck after approximately 20 minutes flight.

f. Adjust rheostat on voltage regulator until the precision voltmeter indicates 27.7 volts.

CAUTION

- Replace the voltage regulator if voltage creeps above 27.7 volts after final adjustment. Failure to replace an unstable regulator may result in serious electrical system malfunction.
- Do not adjust the carbon pile adjusting screw with the regulator installed on the airplane. Accurate adjustment can only be made with bench-type equipment.

g. Secure engine after completion of check.
h. Disconnect test equipment.

8-44. REMOVING AND INSTALLING VOLTAGE REGULATOR.

REMOVING

1 Make certain no electrical power is applied to airplane.

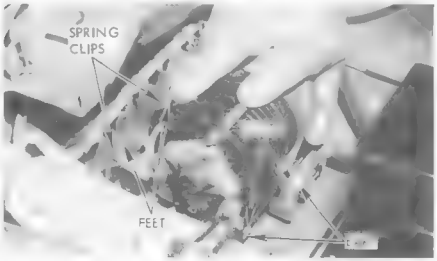
2 Gain access to voltage regulator through top deck electrical bay access panel.

3 Release two spring clips from regulator feet on forward end of voltage regulator.

4 Lift and remove voltage regulator from airplane.

INSTALLING

1 Lower voltage regulator into position on base and slide ears on aft side of regulator into slots on base.



2 Push forward end of regulator down until regulator feet engage in spring clips.

Caution Check ground wire from L- or G terminal to ground for good connections.

3 Perform operational check of voltage regulator as described in paragraph 8-43. FJ-4B-2-54-358

8-45. D-C OVERVOLTAGE PROTECTION SYSTEM — AIRPLANES 141444j AND SUBSEQUENT.

8-46. The d-c overvoltage protection system consists of the overvoltage relay, the anti-cycling relay, the generator field control relay, the starter shunt field control relay, the generator reset switch (GEN RESET) and equipment associated with the d-c generator system. Any overvoltage condition within the d-c generator system which allows the bus voltage to rise to 32 (±1) volts energizes the overvoltage relay. When the overvoltage relay becomes energized, power from the starter-generator is disconnected from the d-c busses, and the starter-generator is disabled in the following sequence. The generator field control relay, normally latched in the reset position, is energized to the trip position by power from the now closed contacts of the overvoltage relay. Contacts on the generator field control relay open the circuit of the starter-generator shunt field, break the trip coil ground return circuit, close the ground return for the reset coil and break the control circuit to the overvoltage relay coil. When all contacts in the generator field control relay assume their trip position configuration, the bus control relay routes battery power to the d-c primary bus and, during flight conditions, power to the d-c secondary and monitored busses is disconnected until the D.C. POWER switch is placed in the "BAT. ONLY" position. (See figure 8-18.) A return to generator power is accomplished by momentarily toggling the GEN RESET switch to "GEN-RESET," thus operating the anti-cycling relay and routing power to the reset coil on the generator field control relay. When the reset coil is energized, generator power immediately is resumed. If the overvoltage condition still exists, the circuit will again actuate the trip coil of the generator field control

relay and disable the starter-generator. Repeated attempts to resume generator power by using the generator reset switch will only cause the overvoltage relay to re-trip the generator field control relay while the overvoltage condition exists.

8-47. OPERATIONAL CHECK OF D-C OVERVOLTAGE PROTECTION SYSTEM—AIRPLANES 141444j AND SUBSEQUENT.

8-48. A ground check with engine installed and operating is recommended for testing and checking of the overvoltage system and can be accomplished as follows:

a. Engage all circuit breakers except the No. 1 and No. 2 inverters. Position all radio and radar switches to the "OFF" position.

b. Connect an AN3155-50-25 rheostat, adjusted for maximum resistance, between terminals "F+" or "A" (test point PJ) and "L+" or "B" (test point PK) on the voltage regulator.

c. Connect a precision voltmeter, 0- to 50-volt d-c scale, between terminals "L+" or "B" (test point PK) and ground on the voltage regulator.

d. Start and accelerate engine to idle rpm. Ensure that the D.C. POWER switch is in the "BAT. & GEN" position and the GEN RESET switch is in the "GEN-RESET" position.

e. After engine has stabilized at idle rpm, slowly decrease rheostat resistance to a 30-volt reading on voltmeter.

f. When a 30-volt reading is obtained, continue to decrease rheostat resistance at a rate of 0.2 volt per second until overvoltage relay trips. GEN OUT light will illuminate and generator voltage will suddenly drop to between 2 to 4 volts.

CAUTION

If overvoltage and field control relays have not actuated before generator voltage reaches 35 volts, immediately increase rheostat resistance to maximum value and shut down engine.

g. After GEN OUT light has illuminated and generator voltage has dropped to minimum value, increase rheostat resistance to maximum or generator output to 27.7 volts.

h. Place GEN RESET switch in "GEN-RESET" position and GEN OUT light will de-energize, indicating generator output.

i. Repeat test.

j. After test is completed, shut down engine and remove added precision voltmeter and rheostat.

8-49. BENCH TEST PROCEDURE FOR GENERATOR FIELD CONTROL RELAY.

a. A 1000-ohm-per-volt ohmmeter with a 10,000-ohm scale is required to perform the following test.

b. Electrically place generator field control relay in the "RESET" position by momentarily applying 28 volts dc to pin "B," using relay case as ground.

c. Measure resistance of resistor "R-2" by connecting ohmmeter to pins "H" and "N." Reading must be 400 (±20) ohms.

d. Measure resistance of trip coil by connecting ohmmeter to pin "I" and ground. Reading must be between 7.315 and 8.085 ohms.

e. Measure resistance between pins "N" and "P" with ohmmeter. Reading must be zero ohms.

f. Measure resistance between pins "C" and "D" with ohmmeter. Reading must be zero ohms.

g. Measure resistance between pins "E" and "F" with ohmmeter. Reading must be zero ohms.

h. Apply 6 volts dc to pin "I," using relay case as ground. Trip coil must operate. Reset relay and apply 20 volts dc to pin "G" and ground. Trip coil must operate again.

i. Electrically place generator field control relay in the "TRIP" position by momentarily applying 28 volts dc to pin "I," using relay case as ground.

j. Measure resistance of resistor "R-2" by connecting ohmmeter between pin "B" and ground. Reading must be 20 (±1) ohms.

k. Measure resistance of reset coil by connecting ohmmeter between pin "B" and ground. Reading must be between 3.31 and 3.65 ohms.

l. Check capacitor "C-1" for shorts by connecting ohmmeter between pins "C" and "D."

m. Check capacitor "C-2" for shorts by connecting ohmmeter between pin "I" and ground. If capacitor is shorted, the ohmmeter will read the resistance of the trip coil.

n. Measure resistance between pins "A" and "H" with ohmmeter. Reading must be zero ohms.

o. Measure resistance between pins "J" and "N" with ohmmeter. Reading must be zero ohms.

p. Measure resistance between pins "N" and "K" with ohmmeter. Reading must be zero ohms.

q. Check reset coil for operation by applying 12 volts dc to pin "B," using relay case as ground. Relay must position to "RESET."

Note

If high resistance or open circuit is recorded during the above tests, trip and reset relay several times (preferably with 1- or 2-ampere, 30-volt d-c load on contacts); then, re-check resistance readings.

8-50. BENCH TEST PROCEDURE FOR OVERVOLTAGE RELAY.

Note

A test voltage that can be accurately regulated at the rate of increase of 0.2 volt within a range of 28 to 33 volts dc must be available for this test.

a. Place ohmmeter between terminals "P" and "T."

b. Apply test voltage to terminal "S" with terminal "G" as ground.

c. Slowly increase voltage until zero-ohm reading is indicated on ohmmeter.

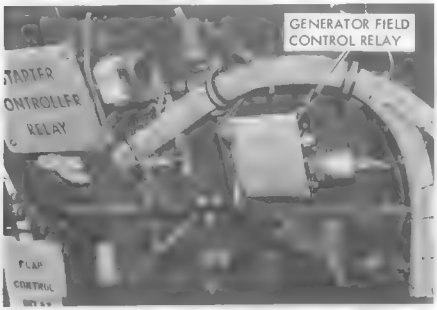
d. For relay to be acceptable, zero-ohm reading should occur when test voltage applied is within 32 (±1) volts.

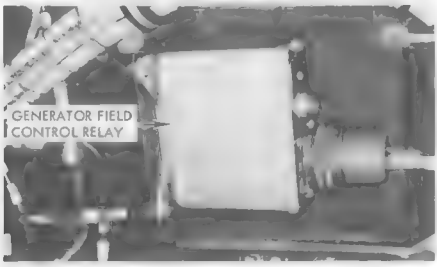
8-51. REMOVING AND INSTALLING GENERATOR FIELD CONTROL RELAY.

REMOVING

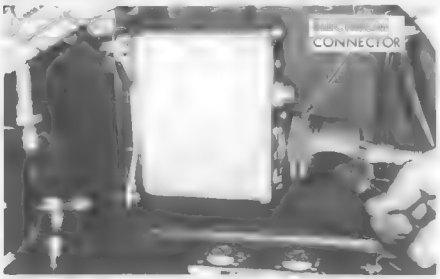
1 Gain access to generator field control relay by removing fuselage aft section and engine. (Refer to paragraphs 5-6 and 5-7.)

Caution Make certain no electrical power is applied to airplane.



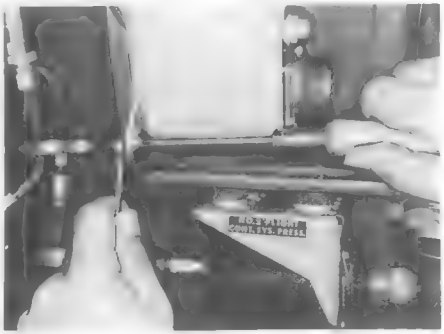


2 Remove safety wire and electrical connector from generator field control relay.



3 Remove two screws and nuts from inboard side of relay and two screws from outboard side of relay. Outboard screws fasten to anchor nuts.

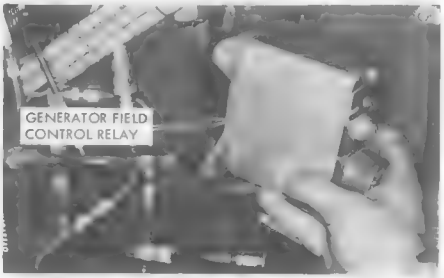
FJ-48-2-54-202



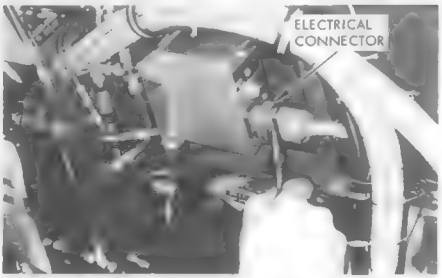
4 Remove generator field control relay from airplane.

INSTALLING

1 Place generator field control relay in position and secure with four screws and two nuts.



2 Install and safety electrical connector.



3 Install engine and fuselage aft section and perform operational check of d-c overvoltage protection system as described in paragraph 8-47.

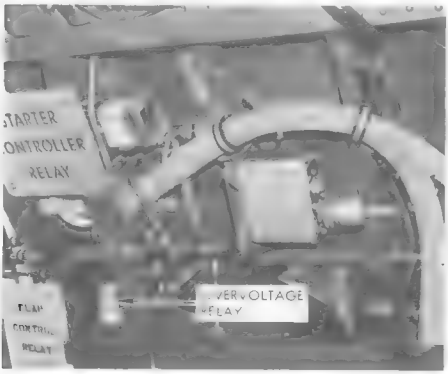
FJ-48-2-54-203

8-52. REMOVING AND INSTALLING OVERVOLTAGE RELAY.

REMOVING

1 Gain access to overvoltage relay by removing fuselage aft section and engine. (Refer to paragraphs 5-6 and 5-7.

Caution Make certain no electrical power is applied to airplane.



2 Remove two screws securing overvoltage relay mounting bracket and lift relay and bracket from mounted position.

3 Remove clamp securing wire bundle to relay.

FJ-4B-2-54-200

Note Relay mounting bracket need not be removed for bench test. If relay is defective, remove two remaining screws securing bracket to relay and install bracket on new relay.

4 Remove two nuts securing terminal cover plate to gain access to relay terminals.

5 Remove wires from terminal studs, making sure to tag wires or record wire numbers.

6 Remove overvoltage relay from airplane.

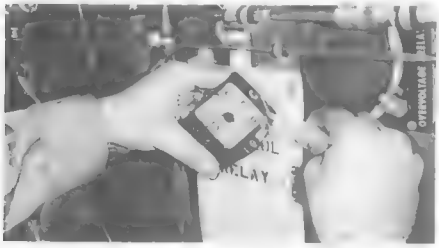
FJ-4B-2-54-201

INSTALLING

Note In case of overvoltage relay failure, type TD-805H-3, TD-805H and TD-805 relays may be installed as substitutes until type TD-812A relays are available. Type TD-800 relays are not to be installed without the specific approval of the Bureau of Aeronautics. The installation of the Type TD-812A relays will be identical because of no change in circuit or wiring configurations.

1 If overvoltage relay bracket was removed, secure bracket to relay by installing two screws and nuts. Do not install third screw and nut, which secures clamp to relay, until wire connections have been completed.

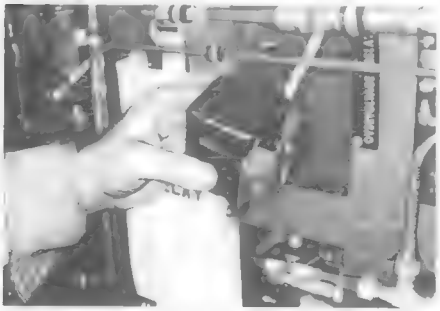
2 Using wiring diagram or tags, install all wires on overvoltage relay.



3 Install terminal cover plate and secure with two nuts, making sure terminal cover plate is mounted flush over terminals.

4 Install clamp securing wire bundle to relay with third screw and nut.

5 Place overvoltage relay and bracket in position and secure with two screws.



6 Install engine and fuselage aft section and perform operational check of d-c overvoltage protection system as described in paragraph 8-47.

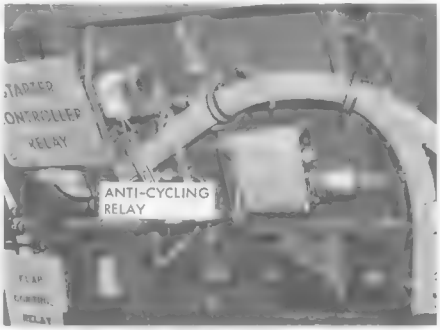
FJ-48-2-54-210

8-53. REMOVING AND INSTALLING ANTI-CYCLING RELAY.

REMOVING

1 Gain access to anti-cycling relay by removing fuselage aft section and engine. (Refer to paragraphs 5-6 and 5-7.)

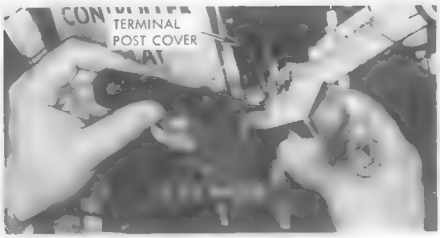
Caution Make certain no electrical power is applied to airplane.



2 Remove two screws securing anti-cycling relay to bracket on airplane.

3 Lift rubber terminal post cover and remove wires from relay terminals, making sure to tag wires or record wire numbers.

FJ-48-2-54-198



4 Remove anti-cycling relay from airplane.

INSTALLING

1 Using wiring diagram or tags, install wires on anti-cycling relay.

2 Install rubber terminal post cover over anti-cycling relay terminals.

Note When installing rubber terminal post cover, make sure cover is positioned correctly and fits snug around relay.

3 Place anti-cycling relay in position on bracket and secure with two screws.

4 Install engine and fuselage aft section and perform operational check of d-c overvoltage protection system as described in paragraph 8-47.

FJ-4B-2-54-199

8-54. EXTERNAL POWER RECEPTACLES.

8-55. Two external power receptacles are provided: one to supply the airplane's electrical busses and equipment with 28-volt d-c power; the other to supply 35-volt d-c power in starting the jet engine. The receptacles are located on the lower side of the fuselage, just forward of the field break station. The 28-volt d-c external power receptacle is an oval-shaped receptacle, and the 35-volt d-c external starting power receptacle is rectangular shaped. The 28-volt d-c external power receptacle is designed in such a way that part-way removal of the external power plug causes the monitored bus to become de-energized with a corresponding drop in load before the large prong disconnects external power from the primary bus. Arcing between the plug and receptacle during disconnection is thus reduced. When a 35-volt d-c external starting power supply is connected to the airplane's external starting power receptacle, the small and the large positive pins of the receptacle are connected directly to the starter-controller. When the engine STARTER switch is moved to "START," contactor relays in the starter-controller furnish power to rotate the starter-generator. When the engine reaches generator cut-in speed (approximately 23% rpm), the starter-controller automatically removes external power from the starter-generator.

Note

Place the D.C. POWER switch in the "OFF" position while servicing with 28-volt external power.

8-56. CARE OF EXTERNAL POWER RECEPTACLES. Careful insertion and removal of the external power plugs is essential to prevent frequent maintenance and replacement of receptacles. The construction of the external power receptacles and of the associated busses prohibits excessive twisting between the plug and receptacles. The minimum use of side motion and more push and pull during insertion and removal of the plug is important in reducing looseness in the receptacle and associated busses. When looseness occurs, access to torqued nuts is best accomplished by first loosening the entire receptacle mounting bracket from the wing tie rods before attempting to remove the plastic cover assembly. Torquing of bus nuts should be in accordance with proper torque values for electrical studs. (Refer to the General Information paragraphs in this section.) When receptacle pins become pitted or dirty, but remain tight, a fine grade of crocus cloth may be used to burnish the affected surfaces. Coarse emery cloth or other abrasives must never be used for this purpose.

D-C POWER DISTRIBUTION SYSTEM

8-57. D-C POWER DISTRIBUTION SYSTEM.

8-58. The d-c power distribution system is composed of six individual bus systems that distribute power throughout the airplane. Various relays and associated equipment tie the bus systems together to permit maximum flexibility of supply. The bus systems are as follows:

Battery bus system
Primary bus system
Canopy and battery bus system
Secondary bus system
Monitored bus system
Armament bus system

See figure 8-20 for circuit-breaker locations.

8-59. FUNCTION OF D-C POWER DISTRIBUTION SYSTEM.

8-60. The function of the d-c power distribution system is to distribute power throughout the electrical system. Distribution is accomplished by using a system of busses, which are energized depending upon the power source applied and the configuration of the airplane. The bus systems, when energized, power their associated components. Refer to the applicable bus system for components powered by each bus.

8-61. TROUBLE SHOOTING D-C POWER DISTRIBUTION SYSTEM.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: **Generator power applied.**
All circuit breakers engaged.
D.C. POWER switch in "BAT. & GEN" position.
Landing gear handle positioned "DOWN" when noted.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS.			
		PRIMARY BUS	
Defective bus control circuit.	Check test point 2 to ground.	28 volts dc.	Refer to trouble shooting primary bus distribution system.
		Other than 28 volts dc.	Refer to paragraph 8-14, Trouble Shooting D-C Power Supply System.
		SECONDARY BUS	
Defective bus segment.	Check test point 6 to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Replace defective bus segment.
Defective SECONDARY BUS relay.	Check test points PPA and PPB to ground.	28 volts dc at both test points.	Refer to trouble shooting secondary bus distribution system.
		Zero volts at test point PPA.	Replace SECONDARY BUS relay.
		Zero volts at test point PPB.	Continue trouble shooting.
Defective landing gear control handle switch or wiring.	Check test points PPC and PPD to ground. Note Test point PPD should only be checked if landing gear control handle switch is in the "DOWN" position.	28 volts dc.	Replace defective wire to last previous test point.
		Zero volts at test point PPD.	Replace defective power wire.
		Zero volts at test point PPC.	Replace defective landing gear control handle switch or continue trouble shooting.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS. (Cont)			
		SECONDARY BUS	
Defective BUS CONT relay, wiring or circuit breaker.	Check test point PDW to ground.	28 volts dc.	Replace defective BUS CONT relay or attached wiring.
		Zero volts.	Replace defective circuit breaker.
		MONITORED BUS	
Defective bus segment.	Check test point 5 to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Replace defective bus segment.
Defective MONITOR BUS relay.	Check test points PPE and PPF to ground.	28 volts dc at both test points.	Refer to trouble shooting monitored bus distribution system.
		Zero volts at test point PPE.	Replace defective MONITOR BUS relay.
		Zero volts at test point PPF.	Continue trouble shooting.
Defective wiring.	Check test point PPG to ground.	28 volts dc.	Replace defective wire to test point PPF.
		Zero volts.	Continue trouble shooting.
Defective BUS CONT relay, wiring or circuit breaker.	Check test point PDW to ground.	28 volts dc.	Replace defective BUS CONT relay or attached wiring.
		Zero volts.	Replace defective circuit breaker.
		CANOPY AND BATTERY BUS	
Defective bus segment.	Check test point 4 to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Replace defective bus segment.
Defective CANOPY BUS relay.	Check test points PPH and PPJ to ground.	28 volts dc at both test points.	Refer to trouble shooting canopy and battery bus distribution system.
		Zero volts at test point PPH.	Replace defective CANOPY BUS relay.
		Zero volts at test point PPJ.	Continue trouble shooting.
Defective circuit breaker or wiring.	Check test point PJB to ground.	28 volts dc.	Replace defective circuit breaker or wire to test point PPJ.
		Zero volts.	Replace defective wire to test point PPE.
		BATTERY BUS	
Defective bus segment.	Check test point 7 to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Replace defective bus segment.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS. (Cont)			
		BATTERY BUS	
Defective BATTERY BUS relay.	Check test points PPK and PPL to ground.	28 volts dc at both test points.	Refer to trouble shooting battery bus distribution system.
		Zero volts at test point PPK.	Replace defective BATTERY BUS relay.
		Zero volts at test point PPL.	Continue trouble shooting.
Defective D.C. POWER switch or wiring.	Check test points PPM and PPN to ground.	28 volts dc.	Replace defective wire to last previous test point.
		Zero volts at test point PPM.	Replace defective D-C POWER switch.
		Zero volts at test point PPN.	Continue trouble shooting.
Defective BUS CONT relay or wiring.	Check test point PDW to ground.	28 volts dc.	Replace defective BUS CONT relay or attached wiring.
		Zero volts.	Continue trouble shooting.
		ARMAMENT BUS	
Defective wiring.	Check test point 8 to ground.	28 volts dc.	Refer to trouble shooting armament bus system (paragraph 7-7).
		Zero volts.	Replace defective wire(s) to primary bus.

SYSTEM CONDITIONS: Battery power applied.
D.C. POWER switch in "BAT. & GEN" position.
No. 2 inverter disconnected.
All circuit breakers disengaged, except BAT RELAY circuit breaker located on the top deck circuit-breaker panel.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS.			
		PRIMARY BUS	
Defective power wire to battery.	Check test point PPK to ground.	24 volts dc.	Continue trouble shooting.
		Other than 24 volts dc.	Replace defective power wire to battery.
Defective BATTERY BUS relay.	Check test points 7 and PPL to ground.	24 volts dc at both test points.	Refer to trouble shooting primary bus distribution system.
		Zero volts at test point 7.	Replace defective BATTERY BUS relay.
		Zero volts at test point PPL.	Continue trouble shooting.
Defective D.C. POWER switch or wiring.	Check test points PPM and PPN to ground.	24 volts dc at both test points.	Replace defective wire to test point PPL.
		Zero volts at test point PPM.	Replace defective D.C. POWER switch.
		Zero volts at test point PPN.	Continue trouble shooting.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS. (Cont)			
		PRIMARY BUS	
Defective BUS CONT relay or wiring.	Check test point PPP to ground.	24 volts dc.	Replace defective BUS CONT relay or attached wiring.
		Zero volts.	Continue trouble shooting.
Defective circuit breaker or wiring.	Check test point PJE to ground.	24 volts dc.	Replace defective circuit breaker or wire to test point PPP.
		Zero volts.	Trouble shoot canopy and battery bus distribution system.
		SECONDARY BUS	
		Note Landing gear handle must be in the "DOWN" position to energize secondary bus from battery.	
Defective bus segment.	Check test point 6 to ground.	24 volts dc.	Continue trouble shooting.
		Other than 24 volts dc.	Replace defective bus segment.
Defective SECONDARY BUS relay.	Check test points PPA and PPB to ground.	24 volts dc at both test points.	Refer to trouble shooting secondary bus distribution system.
		Zero volts at test point PPA.	Replace SECONDARY BUS relay.
		Zero volts at test point PPB.	Continue trouble shooting.
Defective landing gear control handle switch or wiring.	Check test point PPC to ground.	24 volts dc.	Replace defective wire to test point PPB.
		Zero volts.	Replace defective landing gear control handle switch or attached power wire.
		CANOPY AND BATTERY BUS	
Defective CANOPY BUS relay or wiring.	Check test point PPH to ground.	24 volts dc.	Refer to trouble shooting canopy and battery bus distribution system.
		Zero volts.	Replace defective CANOPY BUS relay or wire to test point PPK.

SYSTEM CONDITIONS: Battery power applied.
D.C. POWER switch in "BAT. ONLY" position.
No. 2 inverter disconnected.
All circuit breakers disengaged, except BAT RELAY circuit breaker located on the top deck circuit-breaker panel.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS.			
		PRIMARY BUS	
Defective power wire to battery.	Check test point PPK to ground.	24 volts dc.	Continue trouble shooting.
		Other than 24 volts dc.	Replace defective power wire to battery.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER AVAILABLE TO MONITORED BUS BUT MONITORED BUS SYSTEMS NOT ENERGIZED. (Cont)			
Defective circuit breakers, bus segments or wiring. (Cont)	Check test point PEA to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Replace defective wire to test point 13.
	Check test points PCB and PBM to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire to test point 13.

SYSTEM CONDITIONS: 28-Volt d-c power applied to airplane.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER AVAILABLE TO CANOPY AND BATTERY BUS BUT CANOPY AND BATTERY BUS SYSTEMS NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs and repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test point PJC to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire to test point PPH.

SYSTEM CONDITIONS: 28-Volt d-c power applied to airplane.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER AVAILABLE TO BATTERY BUS BUT BATTERY BUS SYSTEMS NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs or repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test point PGZ to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire segment to test point PPK.
	Check test point PDU to ground.	28 volts dc.	Replace defective circuit breakers or interconnecting wire.
		Zero volts.	Replace defective wire segment to test point PPK.

SYSTEM CONDITIONS: 28-Volt d-c external power applied to airplane.
D-C power switch in "OFF" position.
GENERATOR circuit breaker engaged.
WARNING LIGHT TEST & RUD. PED. SHAKER circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
GENERATOR FAILURE WARNING LIGHT DOES NOT ILLUMINATE.			
Defective lamps.	Actuate WARNING LIGHT TEST switch and if warning light does not illuminate, check for defective lamps.		Replace defective lamps.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
GENERATOR FAILURE WARNING LIGHT DOES NOT ILLUMINATE. (Cont)			
	Note **Instrument lights energized as required.**		
Defective warning light assembly.	Check test point PWA to ground.	28 volts dc: daytime conditions. 23 volts dc: night time conditions.	Replace defective warning light assembly.
		Other than 23 or 28 volts dc.	Continue trouble shooting.
Defective WARNING LIGHT test switch or wiring.	Check test point PWB to ground.	28 volts dc: daytime conditions. 23 volts dc: night time conditions.	Replace defective WARNING LIGHT TEST switch or wire segment to test point PWA.
		Other than 23 or 28 volts dc.	Continue trouble shooting.
Defective BUS CONT relay, warning light dimming relay, circuit breaker or wiring.	Check test point PDW to ground.	28 volts dc.	Perform wire continuity check to test point PWB. Check concerned switch sections of BUS CONT relay and warning light dimming relay. Replace defective relays or wire segments as required.
		Zero volts.	Replace defective circuit breaker.

8-61. (Deleted.)

8-62. BATTERY BUS SYSTEM.

8-63. The battery bus system is composed of the battery, the battery bus, the battery bus relay, the d-c power switch and associated circuit breakers and equipment. (See figure 8-22.) The battery bus is energized at all times by the battery. The battery bus is connected to the canopy and battery bus through the normally closed contacts of the canopy bus control relay. This feature permits the battery to supply power to the canopy and battery bus except when external or generator power is applied. When the monitored bus is energized by either external power or generator power, the canopy bus control relay is energized, disconnecting the canopy and battery bus from the battery bus and connecting it to the primary bus. With external or generator power from the primary bus and the d-c power switch in either "BAT. ONLY" or "BAT. & GEN" position, the battery bus control relay will be energized, connecting the battery bus to the primary bus. Power loads on the battery bus system are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
EXTERNAL STORES & EMERGENCY RELEASE	Left-hand forward console.	Inboard, intermediate and outboard bomb and rocket release mechanisms (left- and right-hand wings).
MASTER FUEL SHUTOFF & TRANSFER TEST	Left-hand forward console.	Master fuel shutoff valve. Aft fuel transfer pump relay. Fuel transfer pump test control. Wing fuel transfer pump relay. Emergency transfer fuel control.
FLOAT TEST & DROP TANK REFUEL*	Left-hand radio bay circuit-breaker panel.	Dual level float test relay. Dual level float valve.
REFUEL†	Left-hand radio bay circuit-breaker panel.	Aft float test relay. Aft fuel cell shutoff relay.
Direct power load	Through canopy bus relay on top deck electrical panel.	Canopy and battery bus.

*Airplanes 141467j and subsequent
†Airplanes 143543l and subsequent

8-64. CANOPY AND BATTERY BUS SYSTEM.

8-65. The canopy and battery bus system is furnished with power from either the battery bus or the primary bus through the canopy bus relay. When the monitored bus is not energized, the canopy and battery bus obtains its power from the battery bus. When the monitored bus is energized, power through the GUN CAMERA & CANOPY BUS circuit breaker energizes the canopy bus relay and connects the canopy and battery bus to the primary bus. See figure 8-22 for electrical schematic of canopy and battery bus system. Power loads on the canopy and battery bus system are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
CANOPY RELAYS	Top deck circuit-breaker panel.	Canopy control relays.
CANOPY ACTR.	Top deck circuit-breaker panel.	Canopy actuator.
BAT RELAY	Top deck circuit-breaker panel.	Battery disconnect relay.

8-66. PRIMARY BUS SYSTEM.

8-67. The primary bus system supplies power to equipment which is essential to maintain flight and is energized either by the battery, the generator, or external power. (See figure 8-22.) Battery power energizes the primary bus through the battery bus relay, provided the d-c power switch is in the "BAT. ONLY" or "BAT. & GEN" position and the monitored bus is de-energized. Generator power supplies the primary bus through the reverse-current cutout and external power is applied directly to the primary bus through the external power receptacle. Generator power will charge the battery if the d-c power switch is in the "BAT. & GEN" position. Primary bus power loads are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
OIL PRESS IND, TRIM IND & LG POSITION IND* (TRIM IND & LG POSITION IND†)	Left-hand forward console.	Nose gear position indicator. Left-hand main gear position indicator. Right-hand main gear position indicator. Oil pressure indicator.* Trim indicator.
ALTERNATE TRIM & MANUAL FUEL	Left-hand forward console.	Engine junction box. Manual fuel light. Longitudinal trim actuator. Longitudinal trim indicator control relay.‡ Rudder trim actuator.‡ Rudder trim indicator control relay.‡ Lateral trim actuator. Lateral trim indicator control relay.
NORMAL & RUDDER TRIM	Left-hand forward console.	Lateral trim actuator. Lateral trim indicator control relay. Rudder trim actuator. Rudder trim indicator control relay.‡ Longitudinal trim actuator. Longitudinal trim indicator control relay.
GYRO HORIZON	Right-hand forward console.	Vertical gyro control assembly. Vertical gyro. Vertical gyro indicator.
FLT PRESS WARNING	Left-hand radio bay circuit-breaker panel.	Flight control pressure warning light. Hydraulic pressure switches.
T-249 FIN & TA-TB TEST	Left-hand radio bay circuit-breaker panel.	T-249 relay box. Canopy test switch panel.
AFT FUEL SHUT-OFF	Left-hand radio bay circuit-breaker panel.	Aft fuel cell shutoff relays. Aft fuel shutoff valve.
WARNING LIGHT TEST & RUD. PED. SHAKER	Right-hand forward console.	T-208 control panel. Warning lights (test position). Rudder pedal shaker test and approach light hook by-pass switch.

*Airplanes 139531i through 143542k
†Airplanes 143543l and subsequent
‡Airplanes 143493k and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS. (Cont)			
		PRIMARY BUS	
Defective BATTERY BUS relay.	Check test points 7 and PPL to ground.	24 volts dc.	Refer to trouble shooting primary bus distribution system.
		Zero volts at test point 7.	Replace defective BATTERY BUS relay.
		Zero volts at test point PPL.	Continue trouble shooting.
Defective D.C. POWER switch or wiring.	Check test points PPM and PPP to ground.	24 volts dc at both test points.	Replace defective wire to test point PPL.
		Zero volts at test point PPM.	Replace defective D.C. POWER switch.
		Zero volts at test point PPP.	Replace defective wire to BAT RELAY circuit breaker or BATTERY BUS relay.
		SECONDARY BUS	
Defective bus segment.	Check test point 6 to ground.	24 volts dc.	Continue trouble shooting.
		Other than 24 volts dc.	Replace defective bus segment.
Defective SECONDARY BUS relay.	Check test points PPA and PPB to ground.	24 volts dc at both test points.	Refer to trouble shooting secondary bus distribution system.
		Zero volts at test point PPA.	Replace SECONDARY BUS relay.
		Zero volts at test point PPB.	Continue trouble shooting.
Defective wiring.	Check test points PPC and PPD to ground. **Note** Test point PPD not required unless landing gear handle is in the "DOWN" position.	24 volts dc at both test points.	Replace defective wire to test point PPB.
		Zero volts at test point PPD.	Replace defective wire to test point PDW.
		Zero volts at test point PPC.	Continue trouble shooting.
Defective D.C. POWER switch or wiring.	Check test point PPQ to ground.	24 volts dc.	Replace defective D.C. POWER switch or wire segment to test point PPC.
		Other than 24 volts dc.	Continue trouble shooting.
Defective circuit breaker or wiring.	Check test point PDW to ground.	24 volts dc.	Replace defective wire segment to test point PPQ.
		Other than 24 volts dc.	Replace defective circuit breaker.
		CANOPY AND BATTERY BUS	
Defective CANOPY BUS relay or wiring.	Check test point PPH to ground.	24 volts dc.	Refer to trouble shooting canopy and battery bus distribution system.
		Zero volts.	Replace defective CANOPY BUS relay or wire to test point PPK.

SYSTEM CONDITIONS: 28-volt d-c external power applied to airplane.
D.C. POWER switch positioned to "OFF."
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO D-C POWER AVAILABLE AT CIRCUIT BREAKERS.			
		PRIMARY BUS	
Defective wiring.	Check test points 9 and 14 to ground.	28 volts dc.	Refer to trouble shooting primary bus distribution system.
		Other than 28 volts dc.	Replace defective wire(s) to external power receptacle.
		SECONDARY BUS	
Defective bus segment.	Check test point 6 to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Replace defective bus segment.
Defective SECONDARY BUS relay.	Check test points PPA and PPB to ground.	28 volts dc at both test points.	Refer to secondary bus distribution system.
		Zero volts at test point PPA.	Replace SECONDARY BUS relay.
		Zero volts at test point PPB.	Continue trouble shooting.
Defective landing gear control handle switch or wiring.	Check test point PPC to ground.	28 volts dc.	Replace defective wire to test point PPB.
		Zero volts.	Replace defective landing gear control handle switch or attached power wire.
		MONITORED BUS	
Defective bus segment.	Check test point 5 to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts.	Replace defective bus segment.
Defective MONITOR BUS relay or wiring.	Check test points PPE and PPF to ground.	28 volts dc at both test points.	Refer to trouble shooting monitored bus distribution system.
		Zero volts at test point PPE.	Replace MONITOR BUS relay.
		Zero volts at test point PPF.	Replace defective wire to external power receptacle.
		CANOPY AND BATTERY BUS	
		Note	
		Trouble shooting of canopy and battery bus system using external power is identical to procedure using generator power.	
		BATTERY BUS	
		Note	
		Battery bus is not connected to primary bus under the given system conditions.	
		ARMAMENT BUS	
		Note	
		Armament bus is not connected to primary bus under the given system conditions.	

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER IS AVAILABLE TO PRIMARY BUS BUT PRIMARY BUS SYSTEMS ARE NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs or repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test point PHA to ground.	28 volts dc.	Replace defective circuit breaker, bus segment or interconnecting wires as required.
		Zero volts.	Replace defective wire to test point 7.
	Check test point PJA to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Replace defective wire to test point 7.
	Check test point PGK to ground.	28 volts dc.	Replace defective circuit breaker, bus segment or interconnecting wires as required.
		Zero volts.	Replace defective wire to test point 6.
	Check test point 10 to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire to bus.
	Check test point 8 to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s) to test point 10.
	Check test point PCF to ground.	28 volts dc.	Replace defective circuit breaker or bus segment.
		Zero volts.	Replace defective wire to test point 8.
	Check test point PFA to ground.	28 volts dc.	Replace defective circuit breaker or bus segment.
		Zero volts.	Replace defective wire to test point 8.
	Check test point PCG to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Replace defective wire to test point 10.
	Check test point PBJ to ground.	28 volts dc.	Replace defective circuit breakers, bus segments or interconnecting wires.
		Zero volts.	Replace defective wire to test point 10.
	Check test point 11 to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire to bus.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER IS AVAILABLE TO PRIMARY BUS BUT PRIMARY BUS SYSTEMS ARE NOT ENERGIZED. (Cont)			
Defective circuit breakers, bus segments or wiring. (Cont)	Check test points PDG and PDR to ground.	28 volts dc.	Replace defective circuit breaker or bus segment.
		Zero volts.	Replace defective wire to test point 11.
	Check test point PED to ground.	28 volts dc.	Replace defective circuit breakers, bus segments or interconnecting wires.
		Zero volts.	Replace defective wire to test point 11.
POWER AVAILABLE TO SECONDARY BUS BUT SECONDARY BUS SYSTEMS NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs or repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test point PGJ to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire to test point PPA.
	Check test points PCC and PBT to ground.	28 volts dc.	Replace defective circuit breakers, bus segments or interconnecting wire.
		Zero volts.	Replace defective wire segment to test point PPA.
POWER AVAILABLE TO MONITORED BUS BUT MONITORED BUS SYSTEMS NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs or repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test points PGA and PGB to ground.	28 volts dc.	Replace defective circuit breakers, bus segments or interconnecting wire.
		Zero volts.	Replace defective wire segment to test point PPE.
	Check test point PJB to ground.	28 volts dc.	Replace defective circuit breakers.
		Zero volts.	Replace defective wire segment to test point PPE.
	Check test points 12 and 13 to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire segment to test point PPE.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER AVAILABLE TO MONITORED BUS BUT MONITORED BUS SYSTEMS NOT ENERGIZED. (Cont)			
Defective circuit breakers, bus segments or wiring. (Cont)	Check test point PEA to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Replace defective wire to test point 13.
	Check test points PCB and PBM to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire to test point 13.
POWER AVAILABLE TO CANOPY AND BATTERY BUS BUT CANOPY AND BATTERY BUS SYSTEMS NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs and repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test point PJC to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire to test point PPH.
POWER AVAILABLE TO BATTERY BUS BUT BATTERY BUS SYSTEMS NOT ENERGIZED.			
Power distribution wires not secured at busses.			Tighten loose bus studs or repair improperly lugged power wiring.
Defective circuit breakers, bus segments or wiring.	Check test point PGZ to ground.	28 volts dc.	Replace defective circuit breakers or bus segments.
		Zero volts.	Replace defective wire segment to test point PPK.
	Check test point PDU to ground.	28 volts dc.	Replace defective circuit breakers or interconnecting wire.
		Zero volts.	Replace defective wire segment to test point PPK.

SYSTEM CONDITIONS: 28-volt d-c external power applied to airplane.
D.C. POWER switch in "OFF" position.
GENERATOR circuit breaker engaged.
WARNING LIGHT TEST & RUD. PED. SHAKER circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
GENERATOR FAILURE WARNING LIGHT DOES NOT ILLUMINATE.			
Defective lamps.	Actuate WARNING LIGHT TEST switch and if warning light does not illuminate, check for defective lamps.		Replace defective lamps.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
GENERATOR FAILURE WARNING LIGHT DOES NOT ILLUMINATE. (Cont)			
	Note **Instrument lights energized as required.**		
Defective warning light assembly.	Check test point PWA to ground.	28 volts dc: daytime conditions. 23 volts dc: night time conditions.	Replace defective warning light assembly.
		Other than 23 or 28 volts dc.	Continue trouble shooting.
Defective WARNING LIGHT TEST switch or wiring.	Check test point PWB to ground.	28 volts dc: daytime conditions. 23 volts dc: night time conditions.	Replace defective WARNING LIGHT TEST switch or wire segment to test point PWA.
		Other than 23 or 28 volts dc.	Continue trouble shooting.
Defective BUS CONT relay, warning light dimming relay, circuit breaker or wiring.	Check test point PDW to ground.	28 volts dc.	Perform wire continuity check to test point PWB. Check concerned switch sections of BUS CONT relay and warning light dimming relay. Replace defective relays or wire segments as required.
		Zero volts.	Replace defective circuit breaker.

8-62. BATTERY BUS SYSTEM.

8-63. The battery bus system is composed of the battery, the battery bus, the battery bus relay, the d-c power switch and associated circuit breakers and equipment. (See figure 8-23.) The battery bus is energized at all times by the battery. The battery bus is connected to the canopy and battery bus through the normally closed contacts of the canopy bus relay. This feature permits the battery to supply power to the canopy and battery bus except when external or generator power is applied. When the monitored bus is energized by either external power or generator power, the canopy bus relay is energized, disconnecting the canopy and battery bus from the battery bus and connecting it to the primary bus. With external or generator power from the primary bus and the D.C. POWER switch in either "BAT. ONLY" or "BAT. & GEN" position, the battery bus relay will be energized, connecting the battery bus to the primary bus. Power loads on the battery bus system are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
EXTERNAL STORES & EMERGENCY RELEASE	Left-hand forward console.	Inboard, intermediate and outboard bomb and rocket release mechanisms (left- and right-hand wings).
MASTER FUEL SHUTOFF & TRANSFER TEST	Left-hand forward console.	Master fuel shutoff valve. Aft fuel transfer pump relay. Fuel transfer pump test control. Wing fuel transfer pump relay. Emergency transfer fuel control.
FLOAT TEST & DROP TANK REFUEL*	Left-hand radio bay circuit-breaker panel.	Dual level float test relay. Dual level float valve.
REFUEL†	Left-hand radio bay circuit-breaker panel.	Aft float test relay. Aft fuel cell shutoff relay.
Direct power load	Through canopy bus relay on top deck electrical panel.	Canopy and battery bus.

*Airplanes 141467] and subsequent
†Airplanes 143543l and subsequent

D-C POWER LOADING CHART

NO. OF UNITS	EQUIPMENT	AMPS PER UNIT	MAX WATTS PER UNIT	OPERATION
	ARMAMENT AND BOMBING			
4	GUN AMMO BOOSTERS	31.0	858.0	
1	GSAP CAMERA	2.0	55.4	CONTINUOUS
2	GUN-CHARGING VALVE	0.5	13.8	
1	MECHANICAL MOISTURE SEPARATOR HEATER	3.6	99.5	CONTINUOUS
1	GUN SIGHT SYSTEM	1.5	41.5	
1	BOMB AND ROCKET SYSTEM	50.0	1382.0	CONTINUOUS
1	AIR COMPRESSOR	21.0	581.7	CONTINUOUS
1	COMPRESSOR DUMP VALVE	1.5	41.5	CONTINUOUS
1	T-208	50.0	1382.0	
1	LABS	3.2	88.6	
	FLIGHT CONTROLS			
1	SPEED BRAKE SOLENOID VALVE	1.0	27.7	
1	AFT SPEED BRAKE OVERRIDE	1.0	27.7	
1	AILERON TRIM BUNGEE ACTUATOR	1.6	44.3	
1	STABILIZER TRIM BUNGEE ACTUATOR (HOOVER)	3.0	83.1	
	STABILIZER TRIM BUNGEE ACTUATOR (AIRESEARCH)	2.0	55.0	
1	RUDDER TRIM ACTUATOR	3.0	83.1	
2	WING FLAP ACTUATOR	15.0	415.0	
2	INBOARD LEADING EDGE DROOP ACTUATORS	10.0	277.0	
2	OUTBOARD LEADING EDGE DROOP ACTUATORS	5.0	138.2	
	ENGINE INSTRUMENTS			
1	OIL PRESSURE INDICATOR (1)	0.05	1.4	CONTINUOUS
	FLIGHT INSTRUMENTS			
2	SPEED BRAKE POSITION INDICATOR	0.05	1.4	CONTINUOUS
	GYRO COMPASS SYSTEM	0.8	22.2	CONTINUOUS
3	LANDING GEAR POSITION INDICATORS	0.05	1.4	CONTINUOUS
	FLAP POSITION INDICATOR	0.05	1.4	CONTINUOUS
	TRIM POSITION INDICATOR	0.05	1.4	CONTINUOUS
1	ANGLE-OF-ATTACK SYSTEM	7.7	213.0	CONTINUOUS
	LANDING GEAR AND WING FOLDING			
1	WING FOLD SELECTOR VALVE (SINGLE)	.0	27.[illegible]	

(1) AIRPLANES 139531 THROUGH 143542

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Figure No. 8-20. D-C Power Loading Chart (Sheet 1)

NO. OF UNITS	EQUIPMENT	AMPS PER UNIT	MAX WATTS PER UNIT	OPERATION
	LANDING GEAR AND WING FOLDING (CONTINUED)			
1	LANDING GEAR SOLENOID VALVE (DOUBLE)	1.0	27.7	
1	ARRESTING HOOK SOLENOID VALVE	1.0	27.7	
1	EMERGENCY ACCUMULATOR CHARGING VALVE	1.0	27.7	
	HEATING, VENTILATING AND DE-ICING			
1	HEAT EXCHANGER MODULATING VALVE	1.0	27.7	
1	COCKPIT HOT AIR MODULATING VALVE	1.0	27.7	
1	CABIN PRESSURE REGULATOR	0.3	8.3	
1	SYSTEM SHUTOFF VALVE	2.0	55.4	
1	RAM-AIR VALVE	2.0	55.4	
1	CANOPY DEFROST VALVE	2.0	55.4	
1	CABIN AIR SAFETY VALVE	0.2	5.5	
1	PITOT HEATER	4.6	127.4	CONTINUOUS
1	WINDSHIELD ANTI-ICE VALVE	2.0	55.4	
1	WINDSHIELD DEFROST VALVE	2.0	55.4	
	ENGINE CONTROLS			
1	STARTER CONTROL	5.0	13.8	
	LIGHTING			
77	CONSOLE INSTRUMENT PANEL LIGHTS	0.04	1.1	CONTINUOUS
5	AUXILIARY RED FLOODLIGHTS	0.19	53.0	CONTINUOUS
1	TAILLIGHT	0.8	22.2	CONTINUOUS
2	WING TIP LIGHTS	0.75	20.8	CONTINUOUS
1	EXTERIOR LIGHTS FLASHER	1.0	27.7	CONTINUOUS
2	FUSELAGE FORMATION LIGHTS	0.3	8.3	CONTINUOUS
3	APPROACH LIGHT	1.2	33.2	CONTINUOUS
2	FUSELAGE SIGNAL LIGHTS	2.8	77.5	CONTINUOUS
1	LANDING LIGHT	18.0	498.6	CONTINUOUS
1	MISSION DATA LIGHT	0.17	4.7	CONTINUOUS
	MISCELLANEOUS			
1	FIRE DETECTOR CONTROL UNIT			EMERGENCY ONLY
78	MISCELLANEOUS POWER AND CONTROL RELAYS	0.12	3.3	
1	CANOPY SEAL VALVE	0.3	8.3	CONTINUOUS

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Figure No. 8-20. D-C Power Loading Chart (Sheet 2)

NO. OF UNITS	EQUIPMENT	AMPS PER UNIT	MAX WATTS PER UNIT	OPERATION
	MISCELLANEOUS (CONTINUED)			
1	INSTRUMENT PANEL VIBRATOR	0.3	8.3	CONTINUOUS
1	CANOPY ACTUATOR	21.3	589.0	
1	PILOT'S ACTUATOR	8.0	222.0	
1	GUN BAY PURGE DOOR HYDRAULIC SOLENOID VALVE	1.0	27.7	
1	RUDDER PEDAL SHAKER	0.5	13.9	
	D-C POWER			
1	NO. 2 INVERTER (2500 VA) [1]	91.5	2680.0	CONTINUOUS
1	NO. 2 INVERTER (1500 VA) [2]	67.3	1864.0	CONTINUOUS
1	NO. 1 INVERTER (250 VA)	14.8	410.0	CONTINUOUS
	FUEL AND OIL			
2	DROP TANK RELEASE SOLENOID	8.4	232.5	
1	FORWARD FUEL BOOSTER PUMP	17.0	471.0	CONTINUOUS
1	AFT FUEL BOOST PUMP	17.0	471.0	CONTINUOUS
1	AFT FUEL TRANSFER PUMP	17.0	471.0	
1	WING FUEL TRANSFER PUMP	17.0	471.0	
1	DUAL LEVEL FLOAT VALVE	0.6	16.6	
1	WING TANK FUEL TRANSFER VALVE	2.0	55.4	
1	WING TANK VENT VALVE	0.5	13.9	
1	MASTER FUEL SHUTOFF VALVE	2.0	55.4	
1	DROP TANK AIR SOLENOID VALVE	1.1	30.5	
1	AFT FUEL SHUTOFF VALVE [3]	2.0	55.4	
	RADIO			
1	UHF COMMAND SET RECEIVER-TRANSMITTER	19.1	529.1	CONTINUOUS
1	AUTOMATIC DIRECTION FINDER	2.0	55.4	CONTINUOUS
1	OMNI-RANGE RECEIVER (WHEN INSTALLED)	6.5	181.0	CONTINUOUS
1	RADIO SET, AN/ARN-21 (WHEN INSTALLED)	0.7	19.4	CONTINUOUS
	RADAR			
1	IFF RECEIVER-TRANSMITTER	1.4	38.8	CONTINUOUS
1	RADAR EQUIPMENT	3.2	88.6	CONTINUOUS
	WARNING			
11	MISCELLANEOUS WARNING LIGHTS	0.17	4.7	

[1] Airplanes 141444 and subsequent and airplanes 1395311 through 1395551 having Phase IV of Service Change No. 151 complied with

[2] Airplanes 1395311 through 1395551 not having Phase IV of Service Change No. 151 complied with

[3] Airplanes 1435431 and subsequent

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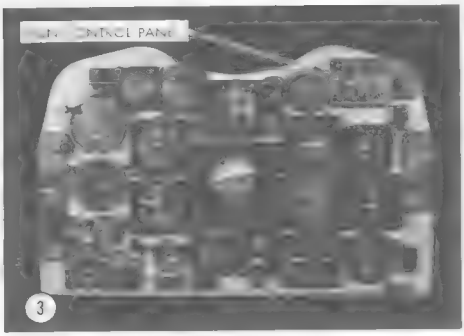
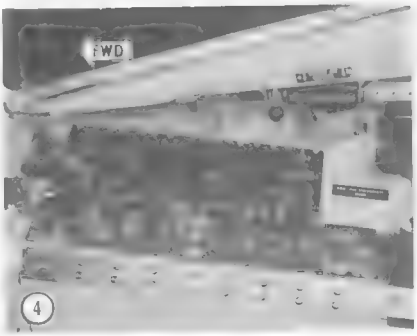
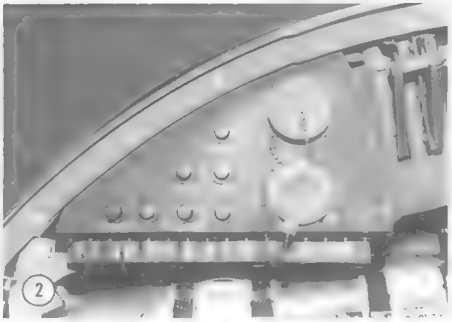
Figure No. 8-20. D-C Power Loading Chart (Sheet 3)



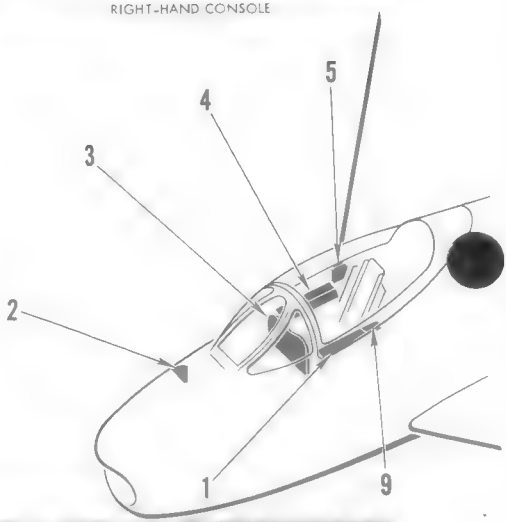
INSTRUMENT PANEL

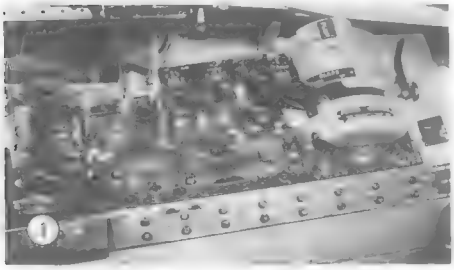


RIGHT-HAND CONSOLE

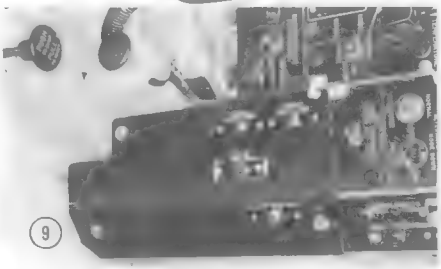


RADAR TEST RECEPTACLE
AND FUSE PANEL





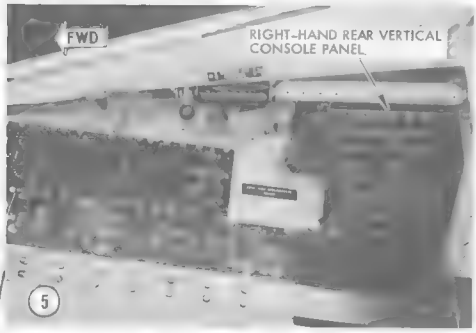
LEFT-HAND CONSOLE



LEFT-HAND REAR CONSOLE

FJ-4B-2-54-36B

Figure No. 8-21. Fuse and Circuit-breaker Locations (Sheet 1)



RIGHT-HAND REAR CONSOLE

ELECTRICAL POWER DISTRIBUTION RELAY PANEL

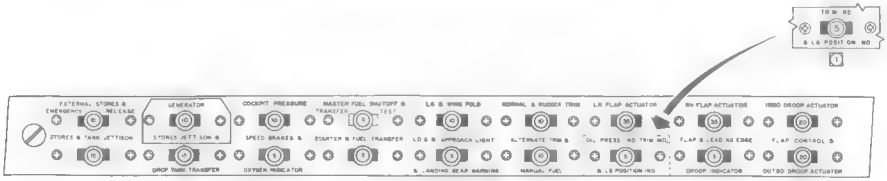
LEFT-HAND RADIO BAY CIRCUIT-BREAKER AND FUSE PANEL

TOP DECK CIRCUIT-BREAKER PANEL

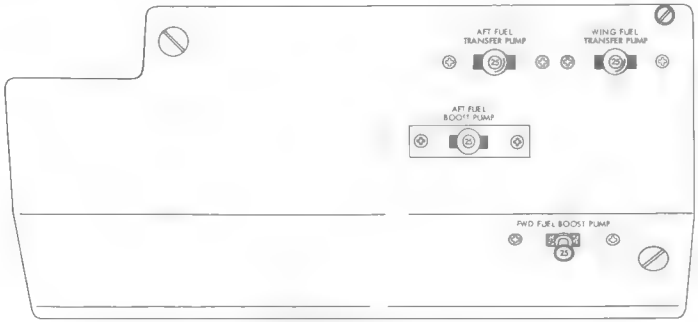
FJ-48-2-54-40A

Figure No. 8-21. Fuse and Circuit-breaker Locations (Sheet 2)

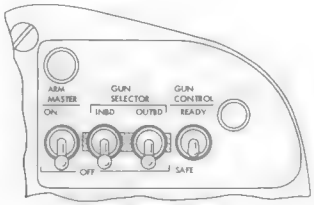
RH FORWARD CONSOLE



LH FORWARD CONSOLE



LH REAR CONSOLE PANEL



ARMAMENT CONTROL PANEL
(ON UPPER RIGHT-HAND INSTRUMENT PANEL)

1 AIRPLANES 143543 AND SUBSEQUENT

PRIMARY
SECONDARY
MONITORED
BATTERY
CANOPY AND BATTERY
ARMAMENT

FJ-48-2-54-B

Figure No. 8-22. Fuse and Circuit-breaker Panels (Sheet 1)

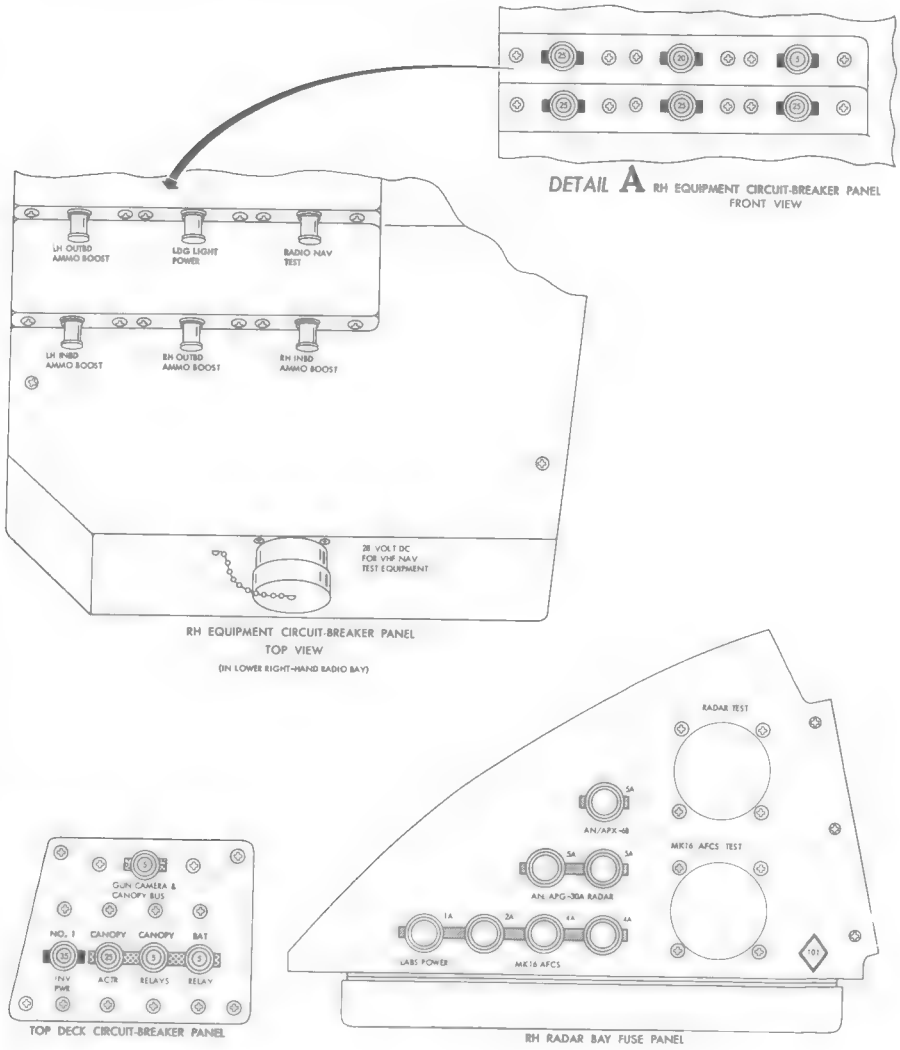


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Figure No. 8-22. Fuse and Circuit-breaker Panels (Sheet 2)

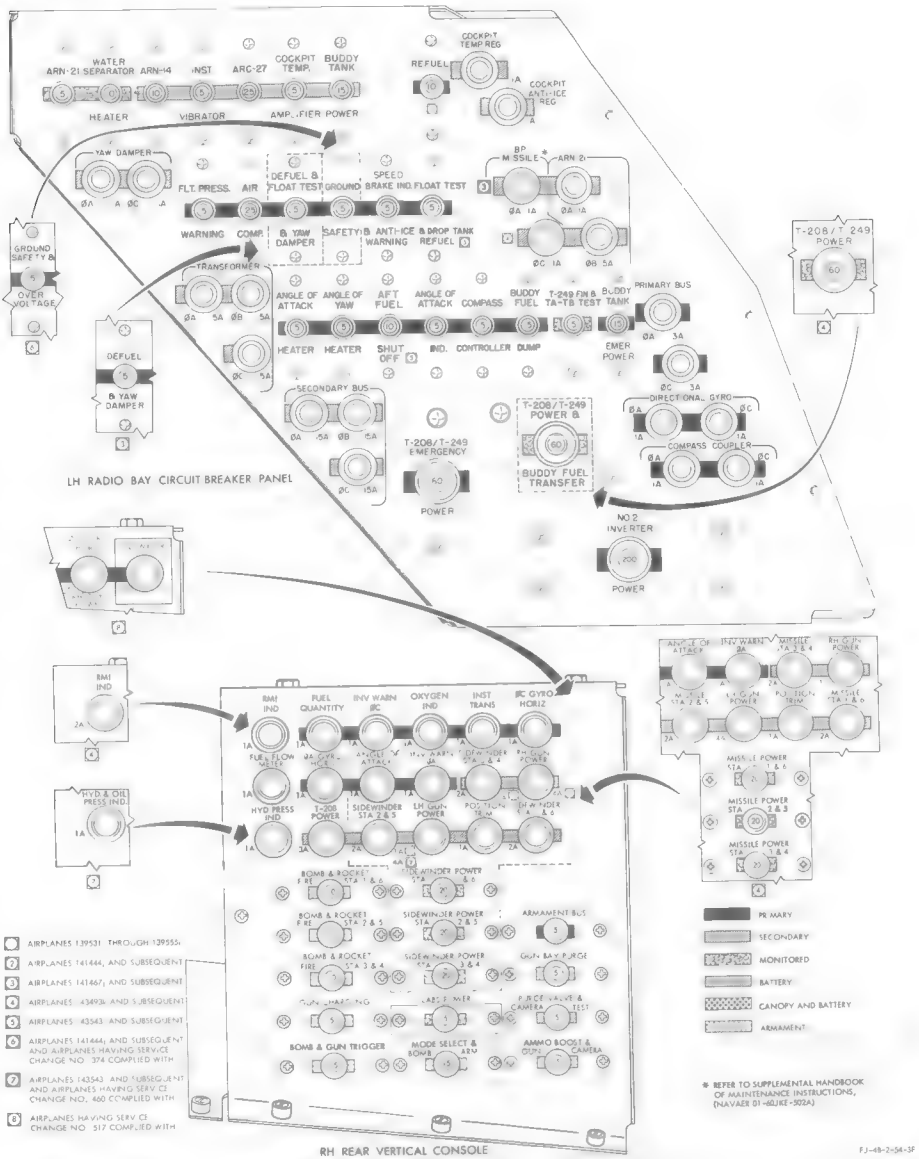


Figure No. 8-22. Fuse and Circuit-breaker Panels (Sheet 3)

8-64. CANOPY AND BATTERY BUS SYSTEM.

8-65. The canopy and battery bus system is furnished with power from either the battery bus or the primary bus through the canopy bus relay. When the monitored bus is not energized, the canopy and battery bus obtains its power from the battery bus. When the monitored bus is energized by either generator or an external power supply, power through the GUN CAMERA & CANOPY BUS circuit breaker energizes the canopy bus relay and connects the canopy and battery bus to the primary bus. See figure 8-23 for electrical schematic of canopy and battery bus system. Power loads on the canopy and battery bus system are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
CANOPY RELAYS	Top deck circuit-breaker panel.	Canopy control relays.
CANOPY ACTR	Top deck circuit-breaker panel.	Canopy actuator.
BAT RELAY	Top deck circuit-breaker panel.	Battery disconnect relay.

8-66. PRIMARY BUS SYSTEM.

8-67. The primary bus system supplies power to equipment which is essential to maintain flight and is energized either by the battery, the generator, or external power. (See figure 8-23.) Battery power energizes the primary bus through the battery bus relay, provided the D.C. POWER switch is in the "BAT. ONLY" or "BAT. & GEN" position and the monitored bus is de-energized. Generator power supplies the primary bus through the reverse-current cutout and external power is applied directly to the primary bus through the external power receptacle. Generator power will charge the battery if the D.C. POWER switch is in the "BAT. & GEN" position. Primary bus power loads are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
OIL PRESS IND, TRIM IND & LG POSITION IND* (TRIM IND & LG POSITION IND†)	Left-hand forward console.	Nose gear position indicator. Left-hand main gear position indicator. Right-hand main gear position indicator. Oil pressure indicator.* Trim indicator.
ALTERNATE TRIM & MANUAL FUEL	Left-hand forward console.	Engine junction box. Manual fuel light. Longitudinal trim actuator. Longitudinal trim indicator control relay.‡ Rudder trim actuator.‡ Rudder trim indicator control relay.‡ Lateral trim actuator. Lateral trim indicator control relay.
NORMAL & RUDDER TRIM	Left-hand forward console.	Lateral trim actuator. Lateral trim indicator control relay. Rudder trim actuator. Rudder trim indicator control relay.‡ Longitudinal trim actuator. Longitudinal trim indicator control relay.
GYRO HORIZON	Right-hand forward console.	Vertical gyro control assembly. Vertical gyro. Vertical gyro indicator.
FLT PRESS WARNING	Left-hand radio bay circuit-breaker panel.	Flight control pressure warning light. Hydraulic pressure switches.
T-249 FIN & TA-TB TEST	Left-hand radio bay circuit-breaker panel.	T-249 relay box. Canopy test switch panel.
AFT FUEL SHUTOFF	Left-hand radio bay circuit-breaker panel.	Aft fuel cell shutoff relays. Aft fuel shutoff valve.
WARNING LIGHT TEST & RUD. PED. SHAKER	Right-hand forward console.	T-208 control panel. Warning lights (test position). Rudder pedal shaker test and approach light hook by-pass switch.

*Airplanes 139531i through 143542k
†Airplanes 143543l and subsequent
‡Airplanes 143493k and subsequent

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
GROUND SAFETY*	Left-hand radio bay circuit-breaker panel.	Ground safety relays.
GROUND SAFETY & OVERVOLTAGE†	Left-hand radio bay circuit-breaker panel.	Generator field.† Ground safety relays.† Missile system.**
SEAT ACTR & UTILITY RECP.	Right-hand forward console.	Pilot's seat actuator. Utility power receptacle.
FLAP CONTROL & OUTBD DROOP ACTUATOR	Left-hand forward console.	Outboard droop actuators. Outboard and inboard droop relays. Flap control relays. Mid flap control switches.
INBD DROOP ACTUATOR	Left-hand forward console.	Inboard droop actuators.
LH FLAP ACTUATOR	Left-hand forward console.	Left-hand flap actuator.
RH FLAP ACTUATOR	Left-hand forward console.	Right-hand flap actuator.
FLAP & LEADING EDGE DROOP INDICATOR	Left-hand forward console.	Flap position indicator.
AIR COMP	Left-hand radio bay circuit-breaker panel.	Air compressor.
ANGLE OF YAW HEATER	Left-hand radio bay circuit-breaker panel.	Angle-of-yaw transducer.
L.H. INBD AMMO BOOST	Right-hand radio bay junction box.	Left-hand inboard ammo boost.
L.H. OUTBD AMMO BOOST	Right-hand radio bay junction box.	Left-hand outboard ammo boost.
R.H. INBD AMMO BOOST	Right-hand radio bay junction box.	Right-hand inboard ammo boost.
R.H. OUTBD AMMO BOOST	Right-hand radio bay junction box.	Right-hand outboard ammo boost.
ANGLE OF ATTACK IND	Left-hand radio bay circuit-breaker panel.	Angle-of-attack indicator. Angle-of-attack transducer. Angle-of-yaw and attack compensator. Approach indexer.¶
ANGLE OF ATTACK HEATER	Left-hand radio bay circuit-breaker panel.	Angle-of-attack heater. Armament master relay.
ARMAMENT BUS	Right-hand rear vertical console.	Ground firing control relay.
DEFUEL & FLOAT TEST & YAW DAMPER‡ DEFUEL & YAW DAMPER§	Left-hand radio bay circuit-breaker panel.	Yaw damper rudder boost cutoff. Wing fuel transfer pump relay. Aft fuel transfer pump relay. Emergency transfer fuel control. Yaw damper gyro amplifier. Dual level float valve.‡
AFT FUEL TRANSFER PUMP	Left-hand rear console panel.	Aft fuel transfer pump.
WING FUEL TRANSFER PUMP	Left-hand rear console panel.	Wing fuel transfer pump. Wing scavenger air shutoff control relay.
STORES & TANK JETTISON	Left-hand forward console.	Stores disconnect stations.
STORES JETTISON & DROP TANK TRANSFER	Left-hand forward console.	Outboard drop tank air solenoid valve. Stores jettison relay. Drop tank air solenoid valve.
STARTER & FUEL TRANSFER	Left-hand forward console.	Starter-Generator. Emergency transfer fuel control. Transfer pump relays.

*Airplanes 139531i through 139555i
†Airplanes 141444j and subsequent
‡Airplanes 139531i through 141466j
§Airplanes 141467j and subsequent
¶Airplanes 143594m and subsequent
**Refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A)

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
NO. 1 INV PWR	Top deck circuit-breaker panel.	No. 1 inverter.
COMPASS CONTROLLER	Left-hand radio bay circuit-breaker panel.	Compass controller.
INVERTER WARN.	Right-hand forward console.	Inverter warning light.
GENERATOR	Left-hand forward console.	Secondary bus relay and monitored bus relay.
T-208/T-249 EMERGENCY POWER	Left-hand radio bay circuit-breaker panel.	T-208/T-249 system relays and busses.
RADIO NAV. TEST	Right-hand radio bay electrical junction box cover.	Radio test receptacle.
LDG LIGHT POWER	Right-hand radio bay junction box cover.	Landing light.
INST. LIGHTS	Right-hand forward console.	Instrument lighting system. Fuel system relays. Low level warning light.
CONSOLE LIGHTS	Right-hand forward console.	Left- and right-hand console lights.
CONSOLE FLOOD LIGHTS	Right-hand forward console.	Left- and right-hand console floodlights.
BUDDY TANK EMER POWER	Left-hand radio bay circuit-breaker panel.	Drogue solenoid cutout relay. Buddy tank guillotine, rewind and trail switches and solenoids.
BUDDY FUEL DUMP	Left-hand radio bay circuit-breaker panel.	Buddy tank dump relay. Buddy tank left-hand dump valve. Buddy tank right-hand dump valve.
INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS	Right-hand forward console.	Instrument floodlights. Cockpit floodlights.
COCKPIT PRESSURE	Left-hand forward console.	Ram-air valve. Cockpit pressure system shutoff valve. Cabin air safety valve. Cabin pressure regulator. Cockpit air control relay. Canopy seal regulator.
SPEED BRAKES & OXYGEN INDICATOR	Left-hand forward console.	Speed brake valve and oxygen indicator.
LDG & APPROACH LIGHT & LANDING GEAR WARNING	Left-hand forward console.	Landing light relay. Landing gear downlock relay. Landing gear warning light and dimming relay. Landing gear position switches. Arresting hook warning light.
LG & WING FOLD	Left-hand forward console.	Emergency accumulator charge valve. Landing gear switch down relay. Wing fold selector valve. Longitudinal trim wheel light.* Statistical accelerometer.†
PITOT HEATER	Right-hand forward console.	Pitot heater.
SPEED BRAKE IND & ANTI-ICE WARNING	Left-hand radio bay circuit-breaker panel.	Windshield anti-ice overheat warning light. Speed brake indicators.
FIRE DETECTOR POWER	Right-hand forward console.	Burner control unit. Compressor control unit.
AFT FUEL BOOST PUMP	Left-hand rear console panel.	Aft fuel boost pump and relay.

*Airplanes 143493k and subsequent

†Airplanes 139531i, 139541i, 139551i, 141449j, 141459j, 141469j, 141479j and 141489j

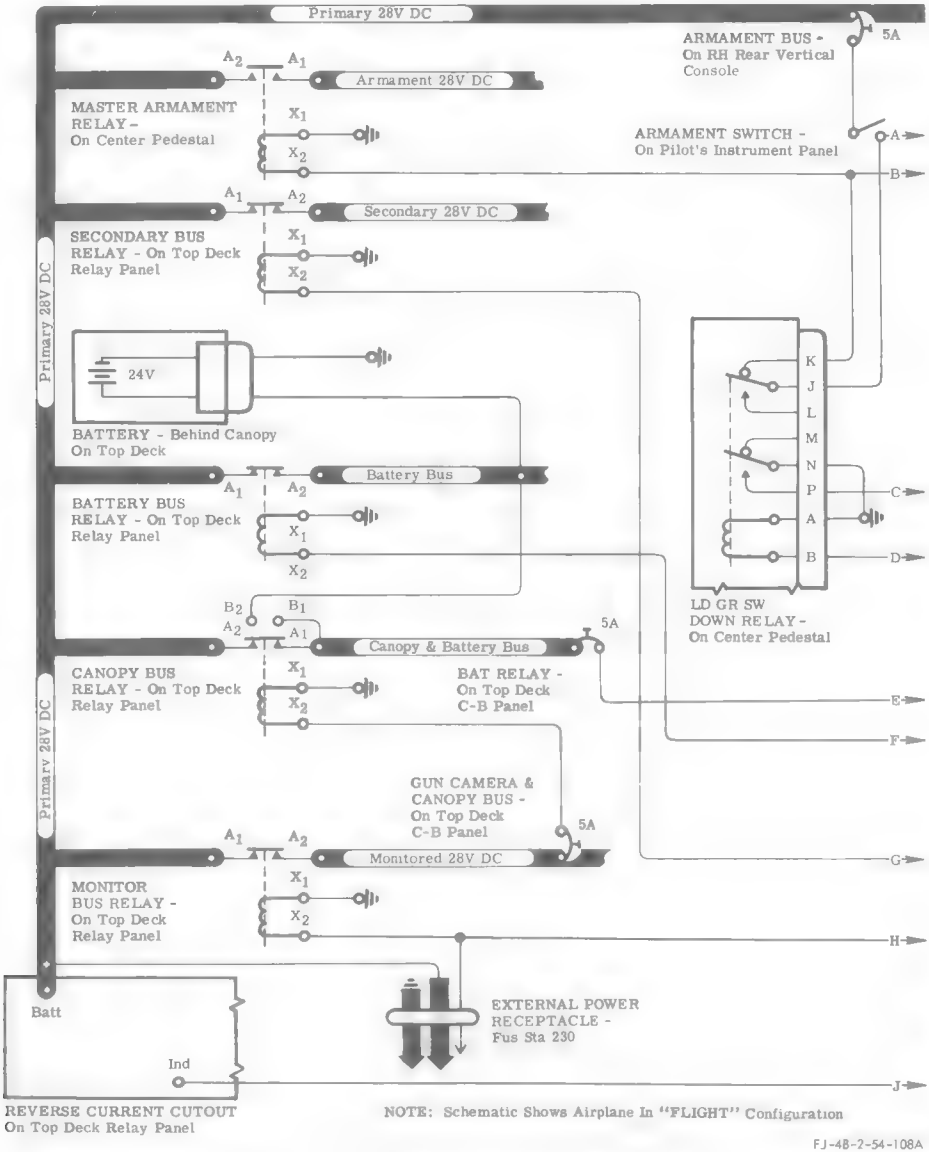


Figure No. 8-23. Bus Distribution System Schematic (Sheet 1)

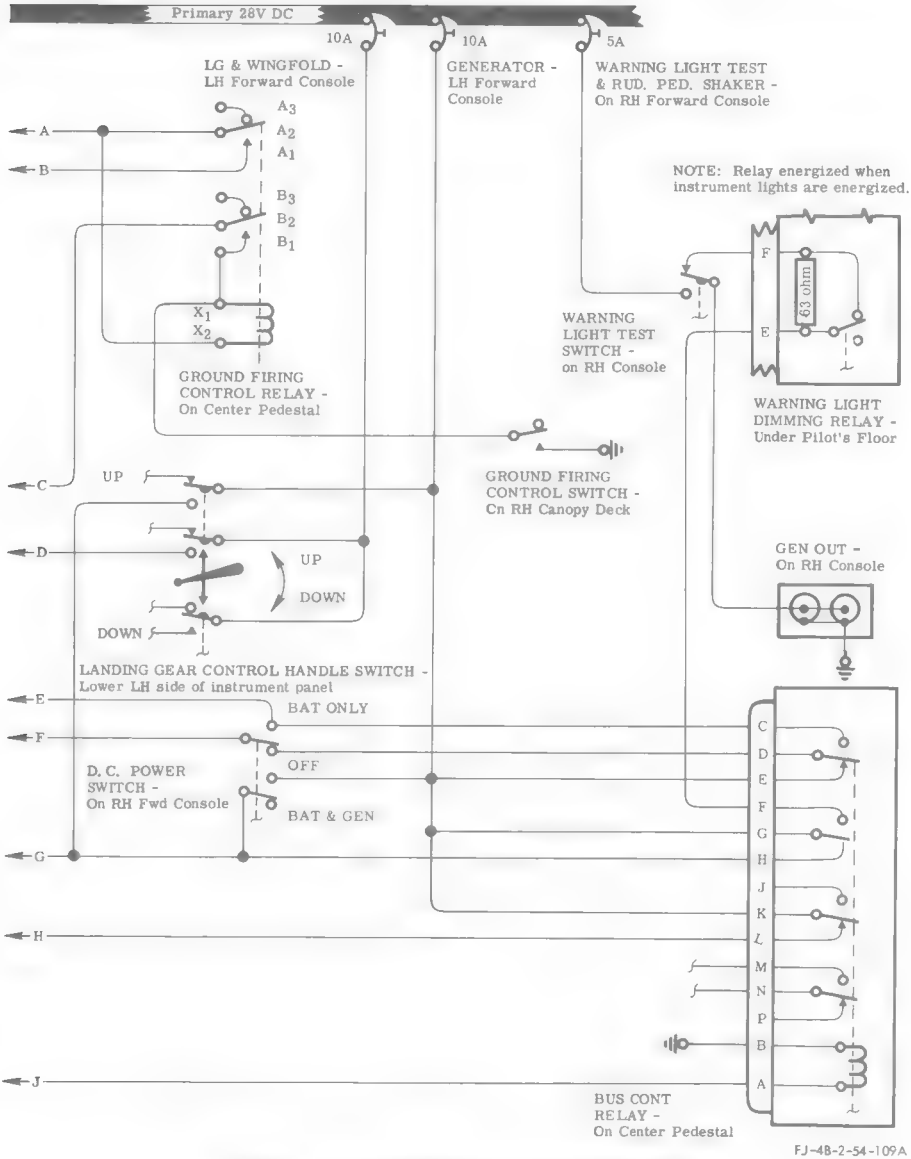


Figure No. 8-23. Bus Distribution System Schematic (Sheet 2)

8-68. SECONDARY BUS SYSTEM.

8-69. The secondary bus system supplies power to certain equipment which is not essential to maintain flight. The system is energized under the following conditions:

a. By generator power with the D.C. POWER switch in the "BAT. & GEN" position.

b. By an external power source applied with the landing gear handle in the "DOWN" position or with the landing gear handle in the "UP" position and the D.C. POWER switch in the "BAT. ONLY" position.

c. By battery power with the landing gear handle in the "UP" position and the D.C. POWER switch in the "BAT. ONLY" position, or with the landing gear handle in the "DOWN" position and the D.C. POWER switch in any position other than "OFF." Under these conditions, power is routed from the primary bus through the secondary bus relay energizing the secondary bus system. See figure 8-23 for electrical schematic of secondary bus system. Secondary bus equipment loads are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
INST VIBRATOR	Left-hand radio bay circuit-breaker panel.	Instrument panel vibrator.
ARN-14	Left-hand radio bay circuit-breaker panel.	Omni-range receiver set, AN/ARN-14E.
ARA-25	Right-hand forward console.	UHF automatic direction finder set, AN/ARA-25.
ARC-27	Left-hand radio bay circuit-breaker panel.	UHF command set, AN/ARC-27A.
FUS SIGNAL LIGHTS	Right-hand forward console.	Exterior fuselage lights. Exterior lights flasher motor.
EXTERIOR LIGHTS	Right-hand forward console.	Approach lights. Approach light relays. Exterior lights control panel indicator light. Exterior wing tip and taillights. Exterior formation lights.
COCKPIT TEMP AMPLIFIER	Left-hand radio bay circuit-breaker panel.	Cockpit temperature control regulator. Cockpit temperature and anti-ice control relay. Cockpit hot air modulating valve. Cockpit air control relay.
BUDDY TANK POWER	Left-hand radio bay circuit-breaker panel.	By-pass valve. Buddy tank system relays. Transfer valve closed indicator light. Air turbine. Internal fuel transfer valve.
ARREST HOOK	Right-hand forward console.	Hook by-pass control relay. Arresting hook valve.
PURGE VALVE & CAMERA TEST	Right-hand rear vertical console.	Purge door valve and camera.

8-70. MONITORED BUS SYSTEM.

8-71. The monitored bus system is composed of the monitored bus, the monitored bus relay and associated circuit breakers and wiring. The monitored bus can be energized either by generator power or external power applied through the external power receptacle. (See figure 8-23.) Generator power through the bus control relay energizes the monitored bus relay, connecting the monitored bus to the primary bus. External power energizing the monitored bus relay and connecting the monitored bus to the primary bus is direct from the external power receptacle. Generator failure in flight will result in the de-energizing of the monitored bus, therefore permitting the battery to power only the equipment necessary to maintain flight. Monitored bus equipment loads are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
NO. 2 INVERTER POWER	Left-hand radio bay circuit-breaker panel.	No. 2 inverter control relay.
T-208/T-249 POWER‡	Left-hand radio bay circuit-breaker panel.	
T-208/T-249 POWER AND BUDDY FUEL TRANSFER‡		
SIDEWINDER POWER STA 1 & 6* MISSILE POWER STA 1 & 6†	Right-hand rear vertical console.	Armament equipment.
SIDEWINDER POWER STA 2 & 5* MISSILE POWER STA 2 & 5†	Right-hand rear vertical console.	Armament equipment.
SIDEWINDER POWER STA 3 & 4* MISSILE POWER STA 3 & 4†	Right-hand rear vertical console.	Armament equipment.
FWD FUEL BOOST PUMP	Left-hand rear console panel.	Forward fuel boost pump.
ARN-21	Left-hand radio bay circuit-breaker panel.	Radio set, AN/ARN-21.
APX-6B‡	Right-hand forward console.	
GUNSIGHT	Right-hand forward console.	Gun sight unit, Mark 8 Mod 8.
APG-30A	Right-hand forward console.	Radar set, AN/APG-30A.
DEFROST ANTI ICE	Right-hand forward console.	Canopy defrost valve. Windshield defrost valve. Windshield anti-ice valve.
GUN CAMERA & CANOPY [redacted]	Top deck circuit-breaker panel.	Canopy and battery bus relay. GSAP camera.
WATER SEPARATOR HEATER	Left-hand radio bay circuit-breaker panel.	Water separator heater.
LABS POWER‡	Right-hand rear vertical console.	

*Airplanes 139531i through 141489j
†Airplanes 143493k and subsequent
‡Refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A)

8-72. ARMAMENT BUS SYSTEM.

8-73. The armament bus system consists of the armament bus, the master armament relay and associated circuit breakers and equipment. (See figure 8-23.) The armament bus can be energized by the primary bus through the armament master switch (ARM MASTER) and the master armament relay when the landing gear handle is placed in the "UP" position. For ground operation, positioning of the ARM MASTER switch to "ON" and momentarily actuating the ground firing control switch (GROUND FIRING CONTROL) energizes the ground firing control relay, completing a circuit to the master armament relay and at the same time establishing a holding circuit through the energized landing gear switch down relay. Energizing the master armament relay connects the armament bus to the primary bus. For further information on the armament system, refer to paragraph 7-5. Power loads on the armament bus are as follows:

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
BOMB & GUN TRIGGER	Right-hand rear vertical console.	GSAP camera. Gun bay purge time delay clutch. Booster relays. Bomb release equipment. Gun firing relay.
BOMB & ROCKET FIRE STA 1 & 6	Right-hand rear vertical console.	Armament equipment.
BOMB & ROCKET FIRE STA 2 & 5	Right-hand rear vertical console.	Armament equipment.

CIRCUIT BREAKER	LOCATION	COMPONENTS POWERED
BOMB & ROCKET FIRE STA 3 & 4	Right-hand rear vertical console.	Armament equipment.
GUN CHARGING	Right-hand rear vertical console.	Gun-charging valves. Gun a-c power relay.
MODE SELECT & BOMB [redacted]	Right-hand rear vertical console.	Arming circuit. Practice bomb relay. Store and tank tie-in relay.
GUN SELECTOR INBD	Pilot's instrument panel.	Inboard gun firing control units, Aero 1B.* Inboard gun power supply, Aero 2A.*
GUN SELECTOR OUTBD	Pilot's instrument panel.	Outboard gun firing control units, Aero 1B.* Outboard gun power supply, Aero 2A.* Inboard gun firing control units, Aero 2A.† Outboard gun firing control units, Aero 2A.†

*Airplanes 139531i through 139555i
†Airplanes 141444j and subsequent

A-C POWER SUPPLY SYSTEM

8-74. A-C POWER SUPPLY SYSTEM.

8-75. The a-c electrical power supply system consists of the No. 1 and No. 2 inverters, the instrument power switch (INST. AC POWER), the No. 1 and No. 2 inverter power circuit breakers (NO. 1 INV PWR and NO. 2 INVERTER POWER) and associated equipment. A power failure warning light operated by the instrument power off warning relay gives indications of partial or complete a-c power system voltage failure. (Refer to paragraph 8-91.)

8-76. FUNCTION OF A-C POWER SUPPLY SYSTEM.

8-77. The instrument power switch (INST. AC POWER), located on the right-hand forward console, selects which inverter is to energize the a-c primary busses. The No. 2 inverter normally supplies 115-volt, 400-cycle, three-phase power directly to the 115-volt a-c secondary busses and can also supply the 115-volt a-c primary busses. The No. 1 inverter supplies only the 115-volt a-c primary busses. The No. 1 inverter can be energized by either of the three sources of d-c power: the battery, the generator or external power. However, the No. 2 inverter can only be energized by generator or external power. The No. 2 inverter is connected so as to provide "Y" connected, three-phase power to the secondary a-c busses and radar equipment at all times. The No. 2 inverter also supplies "delta" three-phase power to the yaw damper system and the gun sight computer at all times. This "delta" connected power is obtained from the wye-delta transformer located in the left-hand radio bay, which connects the wye source to the delta loads. When the INST. AC POWER switch is placed in the "NO. 2 INV." position, the primary a-c "A" and "C" phase busses are energized by the No. 2 inverter through the wye-delta transformer. In this case, primary a-c bus loads are delta-connected with "B" phase grounded. The No. 2 inverter is protected from heavy wye-delta transformer loading by the "A," "B" and "C" phase TRANSFORMER fuses which are located on the left-hand radio bay circuit-breaker panel. Low voltage (26-volt, 400-cycle, single-phase a-c power) is supplied for the navigation and engine instruments by a step-down auto-transformer which derives its power from the 115-volt, "C" phase a-c primary bus. The a-c power supply is protected from overload by the "A" and "C" phase PRIMARY BUS fuses and the "A," "B" and "C" phase SECONDARY BUS fuses located on the left-hand radio bay circuit-breaker panel. See figure 8-24 for a-c power supply system schematic.

8-78. TROUBLE SHOOTING A-C POWER SUPPLY AND DISTRIBUTION SYSTEM.

TEST EQUIPMENT: A-C voltmeter.
D-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
NO. 1 INV PWR and NO. 2 INVERTER POWER circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WARNING LIGHT ILLUMINATED; POSITIONING OF INST. AC POWER SWITCH TO "NO. 2 INV." POSITION EXTINGUISHES LIGHT.			
Defective inverter.	Check test points 21 and 22 to ground.	115 volts ac.	Continue trouble shooting.
		Other than 115 volts ac.	Replace inverter if 28 volts dc is available at test points VA and VB.
Defective wiring.	Check test points XA and XC to ground.	115 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire to last previous test point.
	Check test points XAK and XCH to ground.	115 volts ac.	No action.
		Zero volts.	Replace defective wire to last previous test point.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. AC POWER switch in "NO. 1 INV." position.
NO. 2 INVERTER POWER circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO SECONDARY BUS POWERED SYSTEMS OPERATIVE.			
Defective inverter.	Check test points 23, 24 and 25 to ground.	115 volts ac.	Continue trouble shooting.
	Note If 115-volt a-c reading was obtained, secondary bus loads identified by test points XBA, XAL, XAM and XAN should now be operative.	Other than 115 volts ac.	Replace inverter if 28 volts dc is available at test points VC and VD or VE and VF.
Defective wiring.	Check test points XCJ, XB and XAP to ground.	115 volts ac.	Continue trouble shooting.
	Note If 115-volt a-c reading was obtained, a-c power systems, powered from fuses on right-hand rear vertical console, should now be operative.	Other than 115 volts ac.	Replace defective wire segment to last previous test points.
Defective wiring.	Check test points XAQ and XCL to ground.	115 volts ac.	Replace defective wires to radar bay test receptacle and fuse panel fuses.
		Other than 115 volts ac.	Replace defective wire segment to test points XAR and XCM.

TEST EQUIPMENT: A-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
NO. 1 INV PWR circuit breaker engaged.
INST. AC POWER switch in "NO. 1 INV." position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
YAW DAMPER SYSTEM INOPERATIVE BUT OTHER SECONDARY BUS LOADS OPERATIVE.			
Defective wye-delta transformer, fuses, fuse holders or wiring.	Check test points XAS, XCP, XAT, XCQ and XBC to ground.	115 volts ac.	Replace defective fuses or fuse holders.
		Zero volts at test point XAT.	Replace defective wire to test point XAP.
		Zero volts at test point XCQ.	Replace defective wire to test point XCJ.
		Zero volts at test point XBC.	Replace defective wire to test point XB.
		Zero volts at test point XAS or XCP.	Replace defective wye-delta transformer or attached wires.

8-98. INSTRUMENT POST AND SHIELD LIGHTS.

8-99. All instruments are illuminated by post lights and shield light assemblies with the exception of the stand-by compass and LABS timer indicator which have lamps mounted as an integral part of the instrument. Instruments with two post lights mounted near the edge of each instrument are the fuel flow indicator, fuel quantity indicator, tachometer indicator, oxygen flow indicator, exhaust temperature indicator and the hydraulic pressure indicator. The oxygen quantity indicator, range meter indicator, crystal current meter indicator and the cabin pressure altimeter indicator have one post light. The remote attitude indicator and the turn-and-bank indicator have four lamp shield light assemblies mounted around the faces of the instruments, with the remaining instruments having two lamp shield light assemblies, except the position indicators and the oil pressure indicator which are illuminated by refractor lights. On airplanes 1435431 and subsequent, the oil pressure indicator and the fuel flow indicator are illuminated by three post lights, one of which has a dual illuminating purpose. The operation of the instrument lights is controlled by the instrument lights rheostat (INSTRUMENTS) located on the interior lights control panel. The brilliance of the stand-by compass and range meter indicator lights, controlled by the instrument lights rheostat (INSTRUMENTS), can also be turned "ON" or "OFF" by the stand-by compass and range meter indicator switch (STANDBY COMPASS & RANGE IND). For location of instrument lights and control panels, see figure 8-26.

8-100. FLOODLIGHTS.

8-101. Over-all lighting of the pilot's instrument panel and the left- and right-hand consoles is provided by red floodlights. Two floodlights are located on close-out panels at the sides of the pilot's instrument panel, and the third light is located at the forward edge of the right-hand forward console. These floodlights are powered by the INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS circuit breaker and are controlled by the instrument floodlight switch (INST FLOOD) located on the

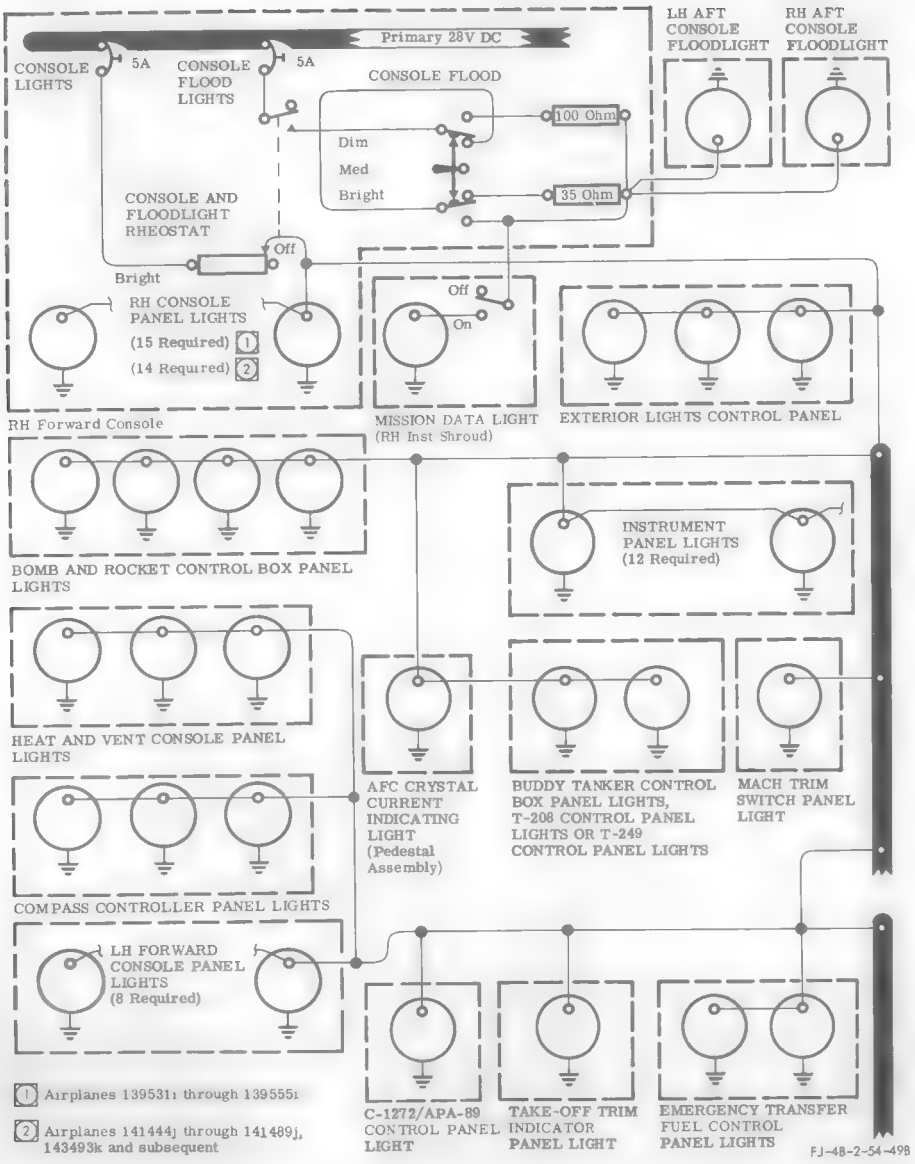


Figure No. 8-27. Interior Lights System (Sheet 1)

TEST EQUIPMENT: A-C voltmeter.
D-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. AC POWER switch in "NO. 2 INV." position.
NO. 2 INVERTER POWER circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WARNING LIGHT ILLUMINATED; POSITIONING OF INST. AC POWER SWITCH TO "NO. 2 INV." POSITION DOES NOT EXTINGUISH LIGHT.			
Defective inverter, wiring or circuit breaker.	If inverter is not rotating, check for 28 volts dc at test points VA and VB to ground and test points VC and VD or VE and VF to ground.	28 volts dc.	Replace defective inverter.
		Zero volts.	Replace defective power wire or circuit breaker.
Defective wiring.	Check test points XAT, XCQ and XBC to ground.	115 volts ac.	Continue trouble shooting.
		Other than 115 volts ac.	Replace defective fuse power input wire.
Defective wye-delta transformer or wiring.	Check test points XAS and XCP to ground.	115 volts ac.	Continue trouble shooting.
		Other than 115 volts ac.	Replace defective wye-delta transformer or attached wiring.
Defective INST. AC POWER switch or wiring.	Check test points XCR and XAU to ground.	115 volts ac.	Replace defective power wire to respective primary bus.
		Other than 115 volts ac.	Replace defective INST. AC POWER switch or wiring to wye-delta transformer.

TEST EQUIPMENT: A-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. AC POWER switch in "NO. 1 INV." position.
NO. 1 INV PWR and NO. 2 INVERTER POWER circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO 26-VOLT A-C POWERED INSTRUMENTS OPERATIVE AND WARNING LIGHT NOT ILLUMINATED.			
Defective bus segment.	Check test point XCB to ground.	115 volts ac.	Continue trouble shooting.
		Other than 115 volts ac.	Replace defective bus segment.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO 26-VOLT A-C POWERED INSTRUMENTS OPERATIVE AND WARNING LIGHT NOT ILLUMINATED. (Cont)			
Defective instrument transformer, power factor correction capacitor, bus segment or wiring.	Check test point XVA to ground.	26 volts ac.	Replace defective bus segment or attached wire.
		Zero volts.	Replace defective instrument transformer or shorted power factor correction capacitor.

TEST EQUIPMENT: A-C voltmeter.
D-C voltmeter.

SYSTEM CONDITIONS: INVERTER WARN. and WARNING LIGHT TEST & RUD. PED. SHAKER circuit breakers engaged.
28-volt d-c power applied to airplane.
Both inverters operating.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WARNING LIGHT ILLUMINATES WITHOUT LOSS OF POWER.			
Defective fuse or wiring.	Check test points FFA and FFB to ground.	115 volts ac.	Continue trouble shooting.
		Zero volts.	Replace blown fuse or defective wire from respective fuse.
Defective INSTRUMENT POWER OFF WARNING RELAY.	Check test point FFC to ground.	Zero volts.	Continue trouble shooting.
		28 volts dc.	Replace defective INSTRUMENT POWER OFF WARNING RELAY.
Defective WARNING LIGHT TEST switch.	Check test point FFD to ground.	Zero volts.	No action.
		28 volts dc.	Replace defective WARNING LIGHT TEST switch.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: INVERTER WARN. circuit breaker engaged.
WARNING LIGHT TEST & RUD. PED. SHAKER,
NO. 1 INV PWR and NO. 2 INVERTER POWER circuit breakers engaged.
28-volt d-c power applied to airplane.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WARNING LIGHT DOES NOT ILLUMINATE WITH LOSS OF POWER.			
Defective INSTRUMENT POWER OFF WARNING RELAY or wiring.	Check test points FFC and FFE to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts at test point FFE.	Replace defective power wire.
		Zero volts at test point FFC.	Replace defective INSTRUMENT POWER OFF WARNING RELAY.
Defective light assembly, WARNING LIGHT TEST switch or wiring.	Check test point FFD to ground.	28 volts dc.	Replace defective light assembly.
		Zero volts.	Replace defective WARNING LIGHT TEST switch or defective wire to last previous test point.

TEST EQUIPMENT: Ohmmeter.

SYSTEM CONDITIONS: INVERTER WARN. circuit breaker disengaged.
INST. LIGHTS circuit breaker engaged.
No a-c power.
INSTRUMENTS rheostat moved from "OFF" position to "BRIGHT" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INVERTERS INOPERATIVE; WARNING LIGHT OPERATES FOR DAYTIME OPERATIONS BUT NOT AT NIGHT.			
Defective warning light dimming relay.	Check between test points FFF and FFC for continuity.	63 ohms.	No action.
		Other than 63 ohms.	Replace defective warning light dimming relay. To check relay solenoid, refer to paragraph 8-96, Trouble Shooting Interior Lighting System.

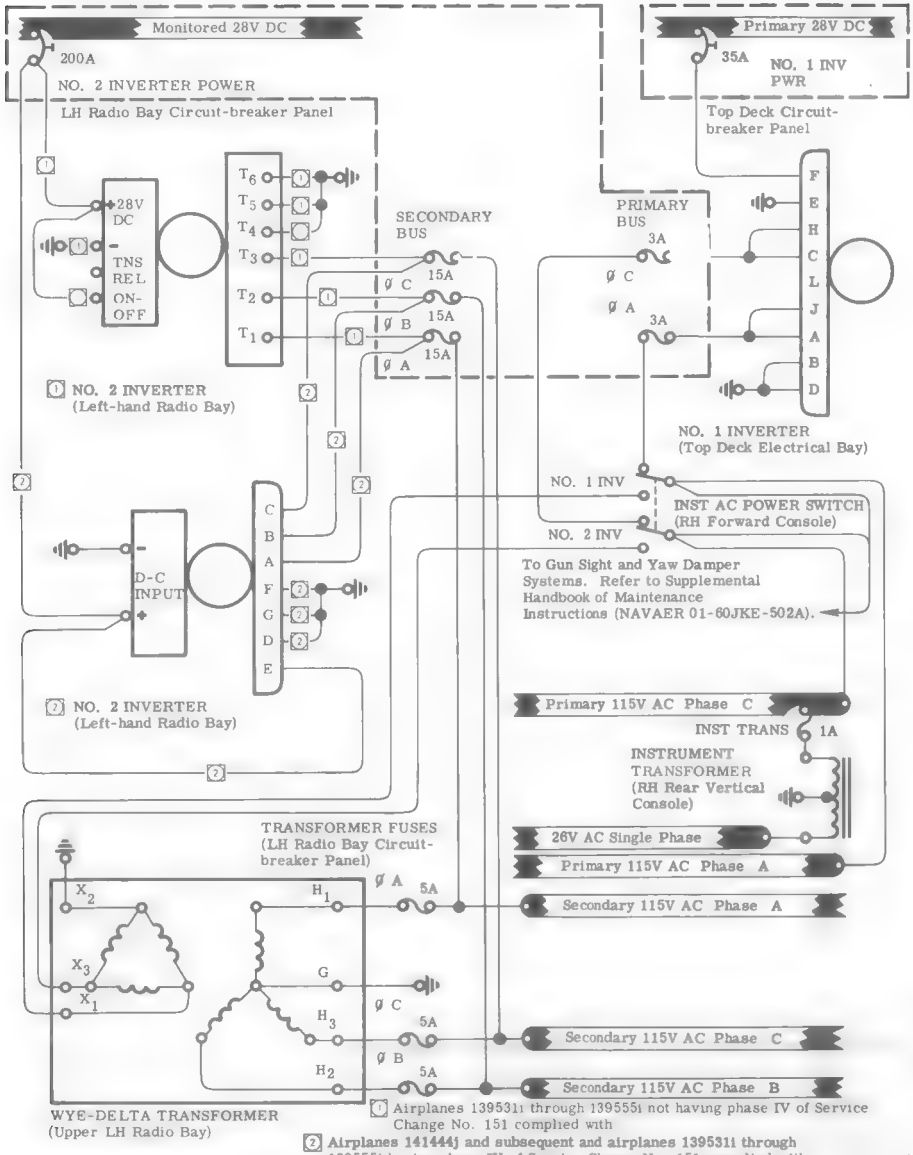
TEST EQUIPMENT: D-C voltmeter.
A-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
All circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER FAILURE.			
Defective circuit breaker.	Check test points PGA and PJA to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
	Check test points PBK and PBD to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
Defective fuse, fuse holder, bus segment or loose bus studs and improperly lugged wiring.	Check test points XAA and XCD to ground.	115 volts ac.	Replace defective fuse or fuse holder.
		Zero volts.	Replace defective bus segment or tighten loose bus studs or improperly lugged power wiring.

8-79. NO. 2 INVERTER.

8-80. On airplanes 139531i through 139555i not having Service Change No. 151 complied with, the No. 2 inverter is a 1500 volt-ampere unit which supplies 115-volt, 400-cycle, three-phase power to the airplane's a-c system. On airplanes 141444j and subsequent and airplanes having Phase IV of Service Change No. 151 complied with, the No. 2 inverter is a larger unit rated at 2500 volt-amperes. D-C power to operate the No. 2 inverter is supplied from the monitored bus through the NO. 2 INVERTER POWER circuit breaker which is located on the left-hand radio bay circuit-breaker panel. On airplanes 139531i through 139551i not having Phase IV of Service Change No. 151 complied with, the heavy current required to run the inverter is supplied through contacts of a relay which is incorporated as a part of the inverter. The NO. 2 INVERTER POWER circuit breaker, once engaged, cannot be disengaged manually; therefore, power to the No. 2 inverter is maintained constantly while the d-c monitored bus is energized. Electrical connections to the No. 2 inverter are shown in figure 8-24. The inverter is located in the left-hand radio bay as shown in figure 8-16 and is cooled by ram air during flight. A plastic deflector is installed at the aft end of the inverter to divert heated inverter air away from the left-hand radio bay circuit-breaker panel. When the No. 2 inverter is operated on deck, either it requires ram air for cooling or the left-hand radio bay access door must be fully open and inverter operation kept at a minimum.

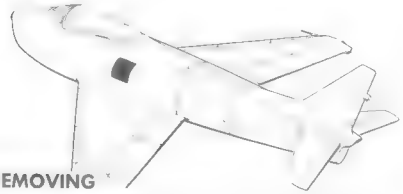


[1] Airplanes 139531i through 139555i not having phase IV of Service Change No. 151 complied with

[2] Airplanes 141444j and subsequent and airplanes 139531i through 139555i having phase IV of Service Change No. 151 complied with FJ-4B-2-54-44A

Figure No. 8-24. A-C Power Supply System

8-81. REMOVING AND INSTALLING NO. 2 INVERTER.



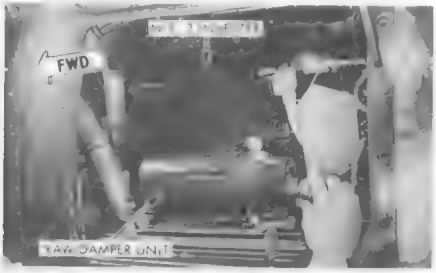
REMOVING

Caution **Make certain that no power is applied to system.**

Note On airplanes 141444j and subsequent and airplanes 139531i through 139555i having phase IV of Service Change No. 151 complied with, the No. 2 inverter is a larger unit rated at 2500 volt-amperes. The larger No. 2 inverter is removed and installed in the same general manner. If the Bendix inverter is used, the boot flange on the inverter must be rotated 180° prior to installation to prevent interference with the heat and vent duct.

1 **Gain access to No. 2 inverter through left-hand radio bay access door.**

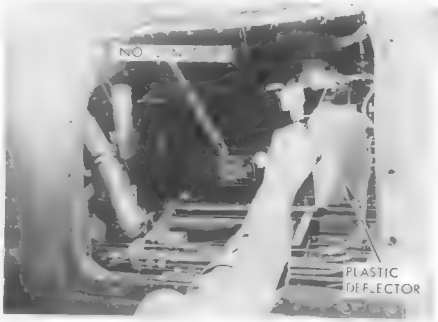
2 **Remove electrical connector from aft end of yaw damper unit.**



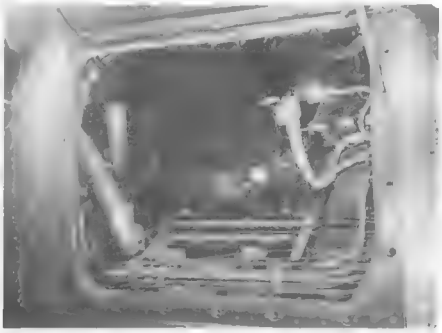
3 **Remove two hex head studs (aft) and two Phillips head screws (forward) from yaw damper unit mounting shelf.**

4 **Remove yaw damper unit, mount and mounting shelf.**

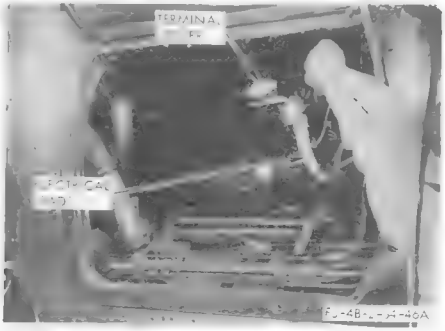
5 **Remove two studs which support aft plastic air deflector and remove deflector.**



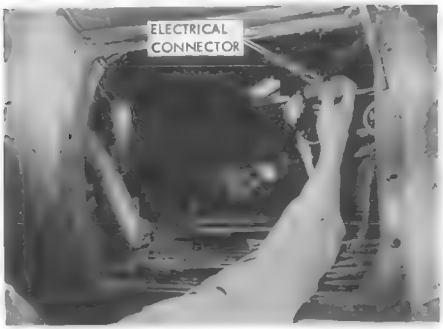
6 **Remove forward stud on inverter shelf and position inverter to most convenient position for removing electrical leads.**



7 **Remove terminal cover and electrical leads.**



8 Remove electrical connector.



9 Slide inverter and shelf outboard and lift carefully from airplane.

Caution If inverter is not to be replaced immediately, make certain that the electrical lead from the positive (+) terminal on the inverter is adequately taped to prevent electrical short in the event that external power is applied.

INSTALLING

1 Lift inverter and shelf onto rails in left-hand radio bay, and position so that large electrical leads can be connected on inverter studs. Install electrical leads on inverter power studs. (Ground lead is connected to negative terminal (-) on the inverter.) Be sure that each terminal has a flat washer and a split lock washer installed and that nuts are properly torqued. (See figure 8-7 for correct torque values.)

2 Install plastic terminal cover.

3 Install and safety electrical connector with AN995F41 wire.

4 Slide inverter inboard until holes in inverter shelf engage with shelf guide pins which project from wall behind inverter. Line up forward and aft shelf mounting holes and install plastic deflector with two hex head bolts; install other hex head bolt on forward edge of shelf.

5 Place yaw damper unit and shelf in position just outboard of inverter and install mounting hardware (two Phillips head screws forward and two hex head bolts aft).

6 Install electrical connector on yaw damper unit and tighten finger-tight.

7 Close and secure access door and perform operational check of No. 2 inverter. (Refer to paragraph 8-82.)

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8-82. OPERATIONAL CHECK OF NO. 2 INVERTER. To perform an operational check of the No. 2 inverter, proceed as follows:

a. Gain access to No. 2 inverter by loosening dzus fasteners on left-hand radio bay access door and lifting and supporting door.

CAUTION

Keep access door open at all times that No. 2 inverter is being run on the ground to assure maximum ventilation.

b. On airplanes 139531i through 139551i not having Phase IV of Service Change No. 151 complied with, remove terminal cover on aft end of inverter control box and connect a calibrated a-c voltmeter to terminals marked "T_1" and "T_4" (test points XAV and XNA).

c. On airplanes 141444j and subsequent and airplanes having Phase IV of Service Change No. 151 complied with, plug meter leads into test receptacles at a-c end of inverter.

d. Connect external power supply to airplane and place INST. AC POWER switch in "NO. 1 INV." position.

Note

Place the D.C. POWER switch in the "OFF" position while servicing the airplane with external power.

e. Make certain that NO. 2 INVERTER POWER circuit breaker is engaged. Inverter should start when external power is turned on and should run up to full speed within 2 seconds, stabilizing at 115 (±2.5) volts after a 10-minute warm-up period.

f. Momentarily place INST. AC POWER switch in "NO. 2 INV." position and note voltmeter reading. Voltmeter should continue to read 115 (±2.5) volts.

g. On airplanes 141444j and subsequent and airplanes having Phase IV of Service Change No. 151 complied with, the operational check is completed in steps a. through f.

h. On airplanes 139531i through 139551i not having Phase IV of Service Change No. 151 complied with, the operational check is continued by connecting voltmeter leads between terminals marked "T_2" and "T_4" (test points XBD and XNA) and between terminals marked "T_3" and "T_4" (test points XCS and XNA) and observing voltage readings with changes in load as described in steps d. through f.

CAUTION

Always disable external power during reconnecting of voltmeter leads. Voltages found on inverter output terminals are lethal and all precautions must be observed when handling inverter. After completion of operational check, turn external power unit off and, on airplanes 139531i through 139551i not having Phase IV of Service Change No. 151 complied with, reinstall terminal cover over test terminals; then, close and secure access door.

8-83. NO. 1 INVERTER.

8-84. The No. 1 inverter is a 250 volt-ampere unit, supplying 115-volt, 400-cycle, three-phase power when selected by the instrument power switch (INST. AC POWER). The inverter is located on the top deck just aft of the d-c voltage regulator. (See figure 8-16.) The No. 1 inverter is powered by the primary bus through the NO. 1 INV PWR circuit breaker located on the top deck circuit-breaker panel. The No. 1 inverter contains a voltage adjustment screw which adjusts all three phases simultaneously. The voltage adjustment screw is located on the aft side of the control box.

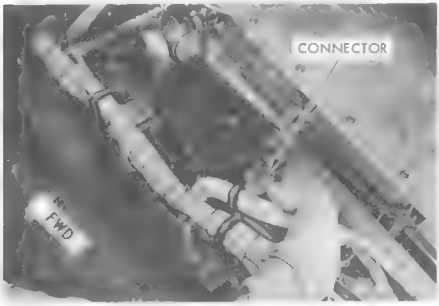
8-85. REMOVING AND INSTALLING NO. 1 INVERTER.

REMOVING

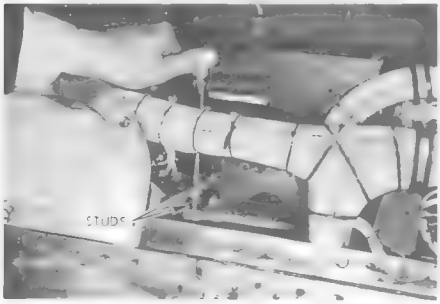
Caution Make certain no electrical power is applied to airplane.

1 Gain access to No. 1 inverter through top deck electrical bay access panel.

2 Remove safety wire and electrical connector from aft end of inverter.



3 Remove two studs on forward end of No. 1 inverter mounting shelf.



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4 Lift forward edge of inverter slightly up and forward.

5 Lift inverter and shelf from top deck electrical panel.

Note If inverter is to be replaced, remove mounting shelf and install on new inverter.

INSTALLING

Caution Make certain no electrical power is applied to airplane.

1 Lift inverter onto top deck electrical panel and position so that two holes in aft end of shelf engage two pins mounted on top deck.

2 Install two studs in holes provided on forward end of No. 1 inverter mounting shelf.

3 Install electrical connector on aft end of inverter and safety with AN995F32 wire.

4 Perform operational check of No. 1 inverter. (Refer to paragraph 8-88.)

5 Secure top deck electrical bay access panel.

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8-86. REPLACING NO. 1 INVERTER BRUSHES. Both a-c and d-c brushes must be replaced when worn to or below the wear mark on the brush. To replace No. 1 inverter brushes, proceed as follows:

a. Remove No. 1 inverter from airplane. (Refer to paragraph 8-85.)

b. Remove inverter side covers by removing four screws from each cover.

c. To replace d-c brushes, remove four screws which secure pigtails of d-c brushes.

d. Lift brush springs carefully off brushes and pull brushes out of brush holders.

e. Install new brushes and run in for 2 hours with half load; then, increase to full load and run inverter until brushes are satisfactorily seated.

Note

- Brush seating must be 100 percent in width and 75 percent in length.
- Install inverter side covers before running in brushes so that the unit will be properly ventilated by the fan.

f. To replace a-c brushes, remove two screws from a-c brush pigtails.

g. Lift brush springs carefully off brushes and remove a-c brushes from brush holders.

h. Install new a-c brushes and secure pigtails with two screws.

i. Run in brushes as in step e., except that contacting surface for a-c brushes must be 75 percent of total contact area.

8-87. CHECKING AND ADJUSTING NO. 1 INVERTER BRUSH SPRING TENSION. When either a-c or d-c brushes have been replaced or become worn, it may be necessary to adjust spring tension. The operation is performed as follows:

a. For d-c brushes, the correct tension is 12 to 14 ounces as measured with a precision-type scale when the spring is lifted 1/8 inch above the flat edge of the brush rest assembly. If it is necessary to readjust spring tension, continue with steps b. and c.

b. Remove cotter pin and turn spring sleeve until correct tension is obtained.

c. Replace cotter pin and re-check adjustment.

d. For a-c brushes, the correct tension is 4 to 6 ounces as measured with a precision-type scale when the spring is lifted 1/8 inch above the flat edge of the brush rest assembly. If it is necessary to readjust tension, continue with steps e. and f.

e. Melt solder on rear end of brush spring post and insert a screwdriver in slot at the other end of spring post.

f. Turn spring post until proper tension is obtained and resolder rear end of post with rosin core solder (item 117, materials list). Re-check adjustment.

8-88. OPERATIONAL CHECK OF NO. 1 INVERTER. To perform an operational check of the No. 1 inverter, proceed as follows:

a. Loosen Camloc fasteners and lift electrical bay access cover on top deck.

b. Locate terminal strip No. 66 just left of aft end of No. 1 inverter and connect a calibrated a-c voltmeter of suitable range to terminals "1" (test point 21) and "2" (test point 22) of terminal strip No. 66.

c. Connect external power unit to airplane's utility power receptacle.

Note

Place the D.C. POWER switch in the "OFF" position while servicing the airplane with 28-volt external power.

d. Engage NO. 1 INV PWR circuit breaker and place INST. AC POWER switch in "NO. 1 INV." position. No. 1 inverter should start and the voltmeter should read 115 (±5) volts after a 10-minute warm-up period. Adjust potentiometer on aft end of inverter, if necessary, to obtain correct reading.

e. Disengage NO. 1 INV PWR circuit breaker and this time reconnect voltmeter between terminal "1" (test point 21) of terminal strip No. 66 and ground.

f. Engage NO. 1 INV PWR circuit breaker and read voltmeter. Reading should be 115 (±5) volts and within 5 volts of actual reading in step d.

g. Disengage NO. 1 INV PWR circuit breaker and reconnect voltmeter between terminal "2" (test point 22) of terminal strip No. 66 and ground.

h. Engage NO. 1 INV PWR circuit breaker and read voltmeter. Reading should be 115 (±5) volts and within 5 volts of actual reading in step d.

i. If correct voltmeter readings cannot be obtained by adjusting the inverter potentiometer, replace inverter.

j. Turn off external power unit, disconnect voltmeter, install terminal strip cover, close top deck access covers and remove external power unit from airplane.

the wing and taillight switch and the exterior lights selector switch are located on the exterior lights control panel (EXTR LTS), on the right-hand forward console. The operating procedure of the taillight is accomplished by placing the EXTERIOR LIGHTS master switch in the "ON" position, the selector switch in either "STDY" or "FLSH" position and the WING & TAIL switch in any position other than "OFF." The wing and tail switch controls the brilliance of the taillight by selecting either the "DIM" or "BRT" position on the switch. When the WING & TAIL switch is placed in the "DIM" position, a resistor is placed in series with the circuit to the taillight, reducing the voltage applied to the taillight. Placing the WING & TAIL switch in the "BRT" position bypasses the resistor and allows the taillight to burn at full brilliance. On airplanes 143618m and subsequent, an additional 18-ohm resistor has been added to the taillight circuit. This added resistor dims the taillight when the WING & TAIL switch is in the "BRT" position. When selected to the "DIM" position, the original dimming resistor combines with the added resistor and provides dimming of the taillight to a greater degree. The taillight is powered by the secondary bus through the EXTERIOR LIGHTS circuit breaker. (See figure 8-28 for schematic.)

8-123. TAILLIGHT BULB REPLACEMENT. To replace a defective taillight bulb, proceed as follows:

a. Remove round-head screws located above and below lens.

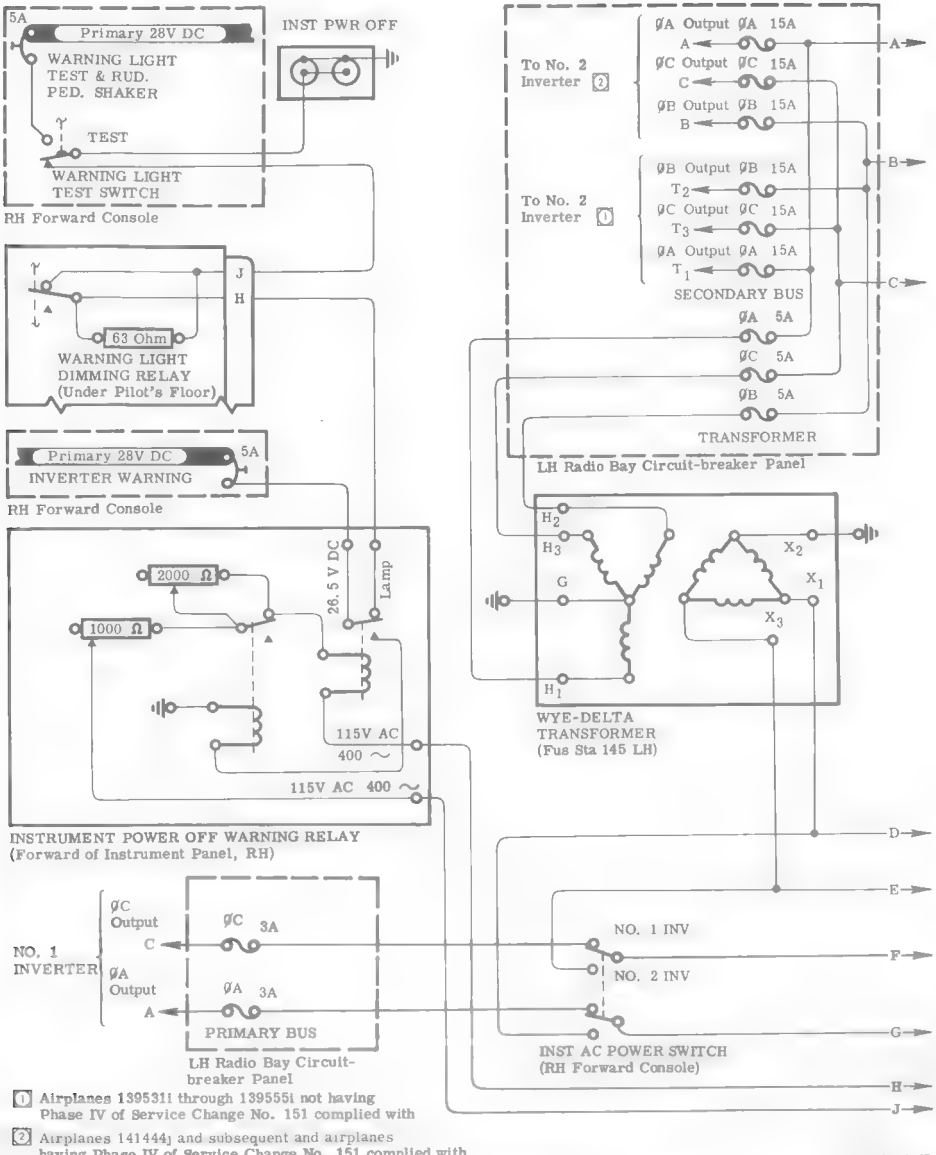
A-C POWER DISTRIBUTION SYSTEM

8-89. A-C POWER DISTRIBUTION SYSTEM.

8-90. The 400-cycle a-c power distribution system consists of the 115-volt, "A" and "C" phase primary busses, 115-volt, "A," "B" and "C" phase secondary busses, delta "A" and "C" phase loads, 26-volt single-phase bus, instrument power transformer, wye-delta transformer and associated equipment. Power is supplied to the 115-volt a-c secondary busses directly from the No. 2 inverter and the delta "A" and "C" phase loads are powered from the wye-delta transformer, while the primary 115-volt a-c busses may be fed by either the No. 1 or No. 2 inverter as selected by the instrument power switch (INST. AC POWER). (See figure 8-25.) When the INST. AC POWER switch is in "NO. 1 INV." position, the No. 1 inverter supplies power to the primary 115-volt busses through the primary bus fuses located on the left-hand radio bay circuit-breaker panel. Simultaneously, the No. 2 inverter is supplying power to the secondary 115-volt busses through the secondary bus fuses also located on the left-hand radio bay circuit-breaker panel. The instrument transformer receives power from the 115-volt, "C" phase a-c primary bus through the INST TRANS fuse located on the right-hand rear vertical console. The output from the instrument power transformer is single-phase, 26 volts ac. Also, in this configuration, all a-c operated equipment may be energized. With the INST. AC POWER switch in the "NO. 2 INV." position, the No. 1 inverter is disconnected from all busses. All 115-volt a-c primary bus loads are then supplied through the wye-delta transformer. The secondary busses and the radar and LABS equipment are directly energized by the No. 2 inverter. The gun sight system, yaw damper system and certain external stores are supplied directly from the No. 2 inverter through the wye-delta transformer. See figure 8-26 for a-c power loading details. Power is distributed to the airplane's a-c loads through the following fuses:

FUSE	LOCATION	COMPONENTS POWERED
	PRIMARY "C" PHASE BUS	
INV WARN	Right-hand rear vertical console.	Instrument power off warning relay.
COMPASS COUPLER	Left-hand radio bay circuit-breaker panel.	Compass coupler.
DIRECTIONAL GYRO	Left-hand radio bay circuit-breaker panel.	Compass gyro.
INST TRANS	Right-hand rear vertical console.	Instrument transformer.
FUEL QUANTITY	Right-hand rear vertical console.	Fuel quantity indicator power unit.
GYRO HORIZ	Right-hand rear vertical console.	Gyro horizon indicator.
COUNTER-POINTER ALTIMETER*	Right-hand rear vertical console.	Counter-pointer altimeter.
PRIMARY BUS ØC	Left-hand radio bay circuit-breaker panel.	Primary a-c bus.
MK16 AFCS	Radar bay test receptacle and fuse panel.	Refer to paragraph 7-196.
OXYGEN IND	Right-hand rear vertical console.	Liquid oxygen indicating system.
	PRIMARY "A" PHASE BUS	
GYRO HORIZ	Right-hand rear vertical console.	Gyro horizon indicator.
COMPASS COUPLER	Left-hand radio bay circuit-breaker panel.	Compass coupler.
DIRECTIONAL GYRO	Left-hand radio bay circuit-breaker panel.	Compass gyro.
ANGLE OF ATTACK	Right-hand rear vertical console.	Angle-of-attack and yaw compensator.
MK16 AFCS	Radar bay test receptacle and fuse panel.	Refer to paragraph 7-196.
INV WARN	Right-hand rear vertical console.	Instrument power off warning relay.
PRIMARY BUS ØA	Left-hand radio bay circuit-breaker panel.	Primary a-c bus.

*Airplanes having Service Change No. 517 complied with



1 Airplanes 1395311 through 1395551 not having Phase IV of Service Change No. 151 complied with

2 Airplanes 141444 and subsequent and airplanes having Phase IV of Service Change No. 151 complied with

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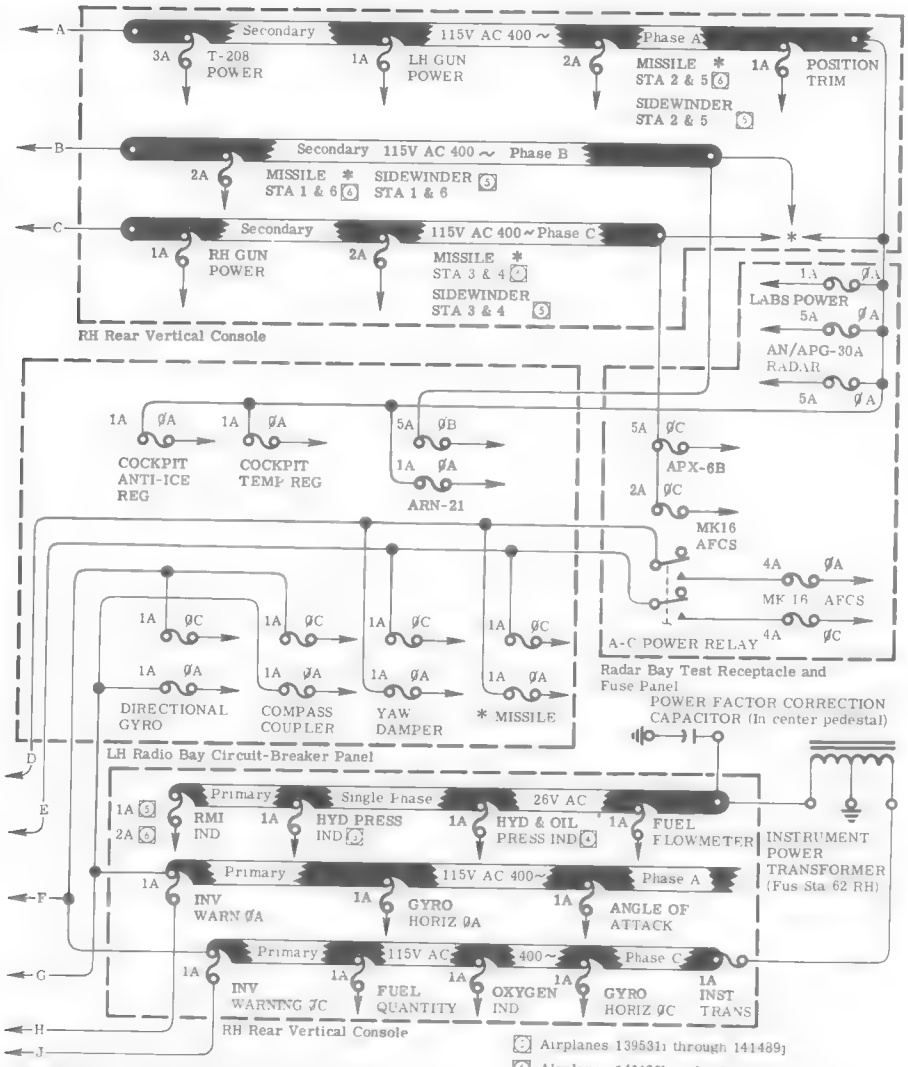
Figure No. 8-25. A-C Power Distribution System (Sheet 1)



3 Airplanes 139531i through 143542k not having Service Change No. 460 complied with

4 Airplanes 143543l and subsequent and airplanes having Service Change No. 460 complied with

5 Airplanes 139531i through 141489j

6 Airplanes 143493k and subsequent

* For further information, refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502.a).

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Figure No. 8-25. A-C Power Distribution System (Sheet 2)

EQUIPMENT	NO. OF UNITS	LOADS PER PHASE					
		PHASE A-B		PHASE A-C		PHASE C-B	
		WATTS	VARS	WATTS	VARS	WATTS	VARS
ANGLE-OF-ATTACK INDICATOR	1	14.8	7.3				
GYRO COMPASS SYSTEM	1	12.3	6.9	12.3	6.9	12.3	6.9
GYRO HORIZON INDICATOR *	1	34.0	12.0	28.0	8.0	14.0	5.0
INSTRUMENT TRANSFORMER	1					9.4	4.2
FUEL QUANTITY INDICATING SYSTEM	1					8.0	-13.9
INVERTER FAILURE RELAY	1			4.3	2.8		
OXYGEN INDICATOR	1					9.5	2.6
COUNTER-POINTER ALTIMETER (1)	1			3.3	1.58		

NO. 1 INVERTER (A-C PRIMARY BUS) NORMAL LOADS

* INCLUDES INSTRUMENT TRANSFORMER LOADS

(1) AIRPLANES HAVING AIRCRAFT SERVICE CHANGE NO. 517 COMPLIED WITH

EQUIPMENT	NO. OF UNITS	LOADS PER PHASE					
		PHASE "A" TO GROUND		PHASE "B" TO GROUND		PHASE "C" TO GROUND	
		WATTS	VARS	WATTS	VARS	WATTS	VARS
IFF TRANSPONDER, APX-6B	1					155.5	75.5
RADAR SET, AN/APG-30A	1	77.0	32.6				
		188.0	74.0				
GUN SIGHT SYSTEM						96.5	75.0
GUN SIGHT COMPUTER	1	45.5	53.0	45.5	53.0	45.5	53.0
YAW DAMPER SYSTEM	1	7.5	5.6	7.5	5.6	7.5	5.6
ANTI-ICE REGULATOR	1	14.0	5.6				
COCKPIT TEMPERATURE REGULATOR	1	15.0	4.4				
GUN FIRING UNITS, LH	2			5.5	10.8	5.5	10.8
GUN FIRING UNITS, RH	2			5.5	10.8	5.5	10.8
RADIO SET, AN/ARN-21	1	50.0	31.2	310.0	62.8		
MISSILES †	6	70.0	19.4	70.0	19.4	70.0	19.4
LAB SYSTEM	1	30.8	9.1				
LONGITUDINAL TRIM	1	20.0	15.0				
T-208 SYSTEM		98.0	61.0				

NO. 2 INVERTER (A-C SECONDARY BUS) NORMAL LOADS

† For further information, refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A)

Note Chart shows No. 1 and No. 2 inverter loads with instrument a-c power switch in No. 1 or normal position. When instrument a-c power switch is in No. 2 or emergency position, the No. 2 inverter assumes all a-c loads. Under emergency conditions, the No. 1 inverter loads are powered by the delta side of the wye-delta transformer. (See figure 8-24.)

This chart may be used to determine power loads for different load conditions. The following formula may be applied:

$$\text{VOLT-AMPERES PER PHASE} = \sqrt{(\text{TOTAL WATTS})^2 + (\text{TOTAL VARS})^2}$$

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Figure No. 8-26. A-C Power Loading Chart

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WING AND TAILLIGHTS FAIL TO ILLUMINATE. (Cont)			
Defective exterior lights control panel.	Check between test points FL2 and LEG.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective exterior lights control panel.
Defective wiring.	Check test point LEH to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire segment to exterior lights control panel.
Defective lamp, light assembly or wiring.	Check test point LEJ to ground.	28 volts dc.	Replace defective right-hand wing tip lamp or light assembly.
		Zero volts.	Replace defective wire segment to test point LEH.

FUSE	LOCATION	COMPONENTS POWERED
	SECONDARY "A" PHASE BUS	
LABS POWER*	Radar bay test receptacle and fuse panel.	
ARN-21	Left-hand radio bay circuit-breaker panel.	Radio set, AN/ARN-21.
LH GUN POWER	Right-hand rear vertical console.	Left-hand inboard and outboard gun power supplies.
COCKPIT TEMP REG	Left-hand radio bay circuit-breaker panel.	Temperature regulator.
COCKPIT ANTI-ICE REG	Left-hand radio bay circuit-breaker panel.	Anti-ice regulator.
AN/APG-30A RADAR (two)	Radar bay test receptacle and fuse panel.	Radar set, AN/APG-30A.
T-208 POWER*	Right-hand rear vertical console.	T-208 control panel and system
TRANSFORMER ∅A	Left-hand radio bay circuit-breaker panel.	Wye-delta transformer.
SECONDARY BUS ∅A	Left-hand radio bay circuit-breaker panel.	Secondary a-c bus.
POSITION TRIM	Right-hand rear vertical console.	Position trim system.
SIDEWINDER STA 2 & 5† MISSILE STA 2 & 5‡ Direct to missile system*	Right-hand rear vertical console.	Station 2 and station 5 Sidewinders and/or missiles.
	SECONDARY "B" PHASE BUS	
TRANSFORMER ∅B	Left-hand radio bay circuit-breaker panel.	Wye-delta transformer.
SECONDARY BUS ∅B	Left-hand radio bay circuit-breaker panel.	Secondary a-c bus.
SIDEWINDER STA 1 & 6† MISSILE STA 1 & 6‡	Right-hand rear vertical console.	Station 1 and station 6 Sidewinders and/or missiles.
ARN-21	Left-hand radio bay circuit-breaker panel.	Radio set, AN/ARN-21.
Direct to missile system*		
	SECONDARY "C" PHASE BUS	
RH GUN POWER	Right-hand rear vertical console.	Right-hand inboard and outboard gun power supplies.
AN/APX-6B	Radar bay test receptacle and fuse panel.	Radar set, AN/APX-6B.
SECONDARY BUS ∅C	Left-hand radio bay circuit-breaker panel.	Secondary phase "C" bus.
TRANSFORMER ∅C	Left-hand radio bay circuit-breaker panel.	Wye-delta transformer.
SIDEWINDER STA 3 & 4† MISSILE STA 3 & 4‡	Right-hand rear vertical console.	Station 3 and station 4 Sidewinders and/or missiles.
MK 16 AFCS	Radar bay test receptacle and fuse panel.	Refer to paragraph 7-196.
Direct to missile system*		
	DELTA LOADS "A" PHASE	
YAW DAMPER ∅A	Left-hand radio bay circuit-breaker panel.	Yaw damper amplifier.
MISSILE ∅A*	Left-hand radio bay circuit-breaker panel.	
Direct to gun sight system		Refer to paragraph 7-218.

*For further information, refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A)

†Airplanes 139531i through 141489j

‡Airplanes 143493k and subsequent

FUSE	LOCATION	COMPONENTS POWERED
	DELTA LOADS "C" PHASE	
YAW DAMPER ∅C	Left-hand radio bay circuit-breaker panel.	Yaw damper amplifier.
MISSILE ∅C*	Left-hand radio bay circuit-breaker panel.	Missile.
Direct to gun sight system		Refer to paragraph 7-218.
	26-VOLT SINGLE-PHASE BUS	
RMI IND	Right-hand rear vertical console.	Radio magnetic indicator, ID-250A/ARN. Course indicator, ID-249/ARN. Bearing converter, ID-251/ARN (airplanes not having Service Change No. 151 complied with). Azimuth indicator, ID-307/ARN-21 (airplanes having Service Change No. 151 complied with). ADF antenna, AS-578/ARA-25.
HYD PRESS IND† HYD & OIL PRESS IND‡	Right-hand rear vertical console.	Hydraulic pressure indicator and transmitter. Engine oil pressure indicator and transmitter.‡
FUEL FLOW METER	Right-hand rear vertical console.	Fuel flowmeter indicator and transmitter.

*For further information, refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A)
†Airplanes 139531 through 143542
‡Airplanes 143543 and subsequent

8-91. INSTRUMENT POWER OFF WARNING RELAY.

8-92. The instrument power off warning relay is incorporated as part of the instrument power failure warning system. Its purpose is to sense a partial or complete failure of power to the 115-volt a-c primary busses and to automatically cause the INST PWR OFF warning light to illuminate. The instrument power off warning relay will not cause the INST PWR OFF warning light to operate in case of abnormally high a-c voltage. The unit actually consists of two relays, one of which is used as an a-c voltage sensing relay and the other which is used to control the "pickup" and "drop out" sensitivity of the a-c voltage sensing relay. (See figure 8-26.) During normal a-c operation, with instrument power above 100 to 105 volts, the a-c voltage sensing relay is energized and the INST PWR OFF warning light voltage is prevented from reaching the light by the open circuit which exists between terminals "LAMP" and "26.5 V D.C." Should the a-c voltage on the primary busses drop sufficiently (90 to 95 volts), the a-c voltage sensing relay is de-energized, allowing a circuit to be made between terminals "LAMP" and "26.5 V.D.C." and illuminating the INST PWR OFF warning light. At the same time, the d-c circuit which had existed between terminals "26.5 V.D.C." and the sensitivity control relay coil is broken and the "pickup" sensitivity of the a-c voltage sensing relay is changed by the shunting of one of the variable resistors so that 100 to 105 volts is necessary to again actuate the a-c voltage sensing relay and turn the INST PWR OFF warning light off. The instrument power off warning relay is located forward of the instrument panel on the right-hand side. Proper access for servicing the unit requires complete removal of the instrument panel. The unit is hermetically sealed. Adjustments shown in figure 8-26 are internal so that improper pickup and drop-out voltages can only be corrected by replacing the unit with a properly adjusted one.

8-93. OPERATIONAL CHECK OF INSTRUMENT POWER FAILURE WARNING SYSTEM. The complete instrument power failure warning system can be checked as follows:

a. Place D.C. POWER switch on right-hand forward console in "OFF" position.

b. Remove two INV WARN fuses on right-hand rear vertical console.

c. Connect continuously variable a-c power source such as 400-cycle variac to two 115-volt a-c, 400-cycle leads to relay. Begin check with a-c power source adjusted to minimum and a-c power disconnected. [Access to 115-volt a-c leads to relay can be found on terminals "7" and "8" (test points FFG and FFH) of terminal

strip No. 20, located in the pedestal.] Read a-c voltage on a suitable properly calibrated voltmeter.

d. Place D.C. POWER switch in a position other than "OFF" and observe INST PWR OFF warning light. Light should be illuminated when D.C. POWER switch is moved from "OFF" position.

e. Gradually raise a-c input voltage to relay and note when INST PWR OFF warning light goes out. Light should go out between 100 and 105 volts.

f. If light goes off properly, reduce a-c voltage to unit and note when light comes on again. The light should illuminate at between 90 and 95 volts.

g. Repeat a-c voltage cycle several times and make certain that INST PWR OFF warning light operates consistently at the same "pickup" and "drop-out" voltages. If INST PWR OFF warning light operates erratically at wrong voltage or not at all, replace instrument power off warning relay with a serviceable item.

h. Return D.C. POWER switch to "OFF" position.

i. Disable variable a-c source and disconnect test wiring.

j. Reinstall INV WARN fuses in right-hand rear vertical console.

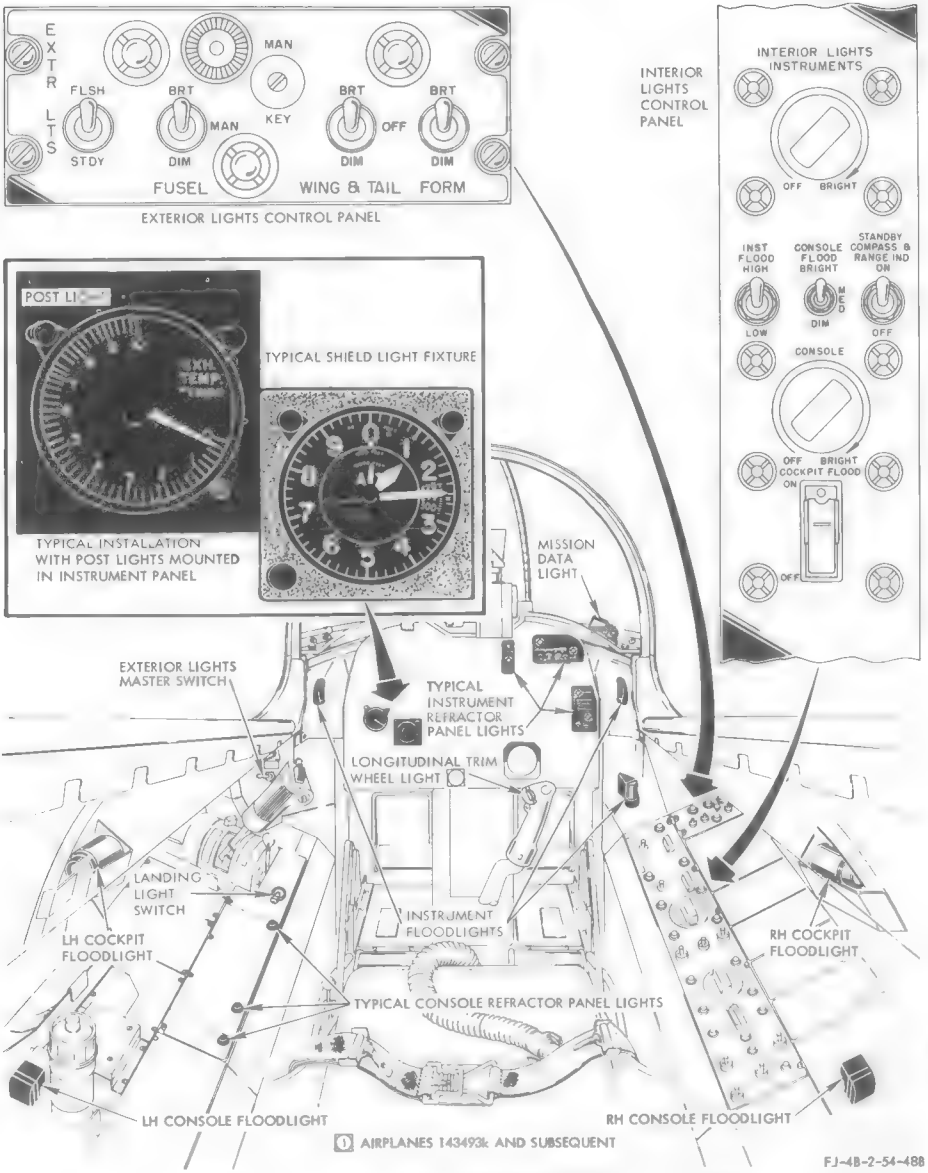


Figure No. 8-27. Interior Lights Location and Lighting Control Panels

INTERIOR LIGHTING SYSTEM

8-94. INTERIOR LIGHTING SYSTEM.

8-95. The interior lighting system (figure 8-28) consists of the refractor panel lights on the pilot's instrument panel and the left- and right-hand consoles, the post- and shield-type lights for the individual instruments, the mission data light, the longitudinal trim wheel light, the warning and indicator lights and the various floodlights located within the cockpit. Controls for the interior lighting system are the instrument lights rheostat (INSTRUMENTS), the console lights rheostat (CONSOLE), the instrument floodlight switch (INST FLOOD), the console floodlight switch (CONSOLE FLOOD), the cockpit floodlight switch (COCKPIT FLOOD) and the stand-by compass and range indicator switch (STANDBY COMPASS & RANGE IND). Power for the interior lighting system is obtained from the d-c primary bus through the INST. LIGHTS, INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS, CONSOLE LIGHTS and CONSOLE FLOOD LIGHTS circuit breakers. Interior lighting is designed so as to give a maximum of instrument and control readability under all operating conditions.

8-96. TROUBLE SHOOTING INTERIOR LIGHTING SYSTEM.

TEST EQUIPMENT: None required.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. LIGHTS circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INSTRUMENT LIGHTS FAIL TO DIM.			
Defective INSTRUMENTS rheostat.			Replace rheostat.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: INST. LIGHTS circuit breaker engaged.
28-volt d-c power applied to airplane.
INSTRUMENTS rheostat moved from "OFF" position toward "BRIGHT."

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INSTRUMENT LIGHTS FAIL TO ILLUMINATE.			
Defective wiring.	Check test point LAA to ground.	28 volts dc.	No action.
		Zero volts.	Continue trouble shooting.
	Check test point LAB to ground.	28 volts dc.	Replace defective wire segment to test point LAA.
		Zero volts.	Continue trouble shooting.
Defective rheostat or wiring.	Check test point LAC to ground.	28 volts dc.	Replace defective wire segment to test point LAB.
		Zero volts.	Replace defective rheostat or attached power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. LIGHTS circuit breaker engaged.
INSTRUMENTS rheostat moved from "OFF" position toward "BRIGHT."
STANDBY COMPASS & RANGE IND switch in the "ON" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
ALL INSTRUMENT LIGHTS ILLUMINATE EXCEPT THE RANGE METER INDICATOR AND STAND-BY COMPASS LIGHTS.			
Defective lamps, lamp assemblies, switch or wiring.	Check test points LAE and LAD to ground.	28 volts dc.	Replace defective lamps or lamp assemblies.
		Zero volts.	Replace defective switch or attached wiring.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
CONSOLE LIGHTS circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INSTRUMENT AND CONSOLE REFRACTOR PANEL LIGHTS FAIL TO DIM.			
Defective CONSOLE rheostat.			Replace rheostat.

SYSTEM CONDITIONS: CONSOLE rheostat moved from "OFF" position toward "BRIGHT."
28-volt d-c power applied to airplane.
CONSOLE LIGHTS circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INSTRUMENT AND CONSOLE REFRACTOR PANEL LIGHTS FAIL TO ILLUMINATE.			
Defective rheostat or wiring.	Check test points LCA and LCB to ground.	28 volts dc.	No action.
		Zero volts.	Continue trouble shooting.
	Check test point LCC to ground.	28 volts dc.	Perform wire continuity check and replace defective wiring.
		Zero volts.	Replace defective rheostat or attached power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
CONSOLE FLOOD LIGHTS circuit breaker engaged.
CONSOLE rheostat moved from "OFF" position.
CONSOLE FLOOD switch in "BRIGHT" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
CONSOLE FLOODLIGHTS FAIL TO ILLUMINATE.			
Defective wiring.	Check test point LFA to ground.	28 volts dc.	Replace defective wires to console floodlights.
		Zero volts.	Continue trouble shooting.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
CONSOLE FLOODLIGHTS FAIL TO ILLUMINATE. (Cont.)			
Defective CONSOLE FLOOD switch, CONSOLE rheostat or wiring.	Check test point LFB to ground.	28 volts dc.	Replace defective CONSOLE FLOOD switch or attached wiring.
		Zero volts.	Replace defective CONSOLE rheostat or attached power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
CONSOLE FLOOD LIGHTS circuit breaker engaged.
CONSOLE rheostat moved from "OFF" position.
CONSOLE FLOOD switch in "MED" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
CONSOLE FLOODLIGHTS BURN EITHER BRIGHT OR DIM WHEN CONSOLE FLOOD SWITCH IS PLACED IN "MED" POSITION.			
Defective CONSOLE FLOOD switch.	Check test point LFA to ground.	Zero volts.	No action.
		28 volts dc.	Replace defective CONSOLE FLOOD switch.
	Check test point LFC to ground.	Zero volts.	No action.
		28 volts dc.	Replace defective CONSOLE FLOOD switch.
NO ILLUMINATION OF CONSOLE FLOODLIGHTS WHEN CONSOLE FLOOD SWITCH IS PLACED IN "MED" POSITION.			
Defective resistor or wiring.	Check test point LFD to ground.	28 volts dc.	Replace defective resistor or attached wiring.
		Zero volts.	Continue trouble shooting.
Defective CONSOLE FLOOD switch, CONSOLE rheostat or wiring.	Check test point LFB to ground.	28 volts dc.	Replace defective CONSOLE FLOOD switch or attached wires.
		Zero volts.	Replace defective CONSOLE rheostat or power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
CONSOLE FLOOD LIGHTS circuit breaker engaged.
CONSOLE rheostat moved from "OFF" position.
CONSOLE FLOOD switch in "DIM" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
CONSOLE FLOODLIGHTS BURN IN MEDIUM BRILLIANCY.			
Defective CONSOLE FLOOD switch.			Replace defective CONSOLE FLOOD switch.
CONSOLE FLOODLIGHTS FAIL TO ILLUMINATE.			
Defective resistor or wiring.	Check test point LFC to ground.	28 volts dc.	Replace defective resistor or attached wiring.
		Zero volts.	Continue trouble shooting.
Defective CONSOLE FLOOD switch or wiring.	Check test point LFG to ground.	28 volts dc.	Replace defective wires to last previous test points.
		Zero volts.	Replace defective switch or power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS circuit breaker engaged.
INST FLOOD switch in the "HIGH" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INSTRUMENT FLOODLIGHTS FAIL TO ILLUMINATE.			
Defective lamps or light assemblies.	Check between test points LFH, LFJ and LFK and ground.	28 volts dc.	Replace defective lamps or light assemblies.
		Zero volts.	Continue trouble shooting.
Defective INST FLOOD switch or wiring.	Check test point LFL to ground.	28 volts dc.	Replace defective wire segment to last previous test points.
		Zero volts.	Replace defective switch or power wire.
INSTRUMENT FLOODLIGHTS ILLUMINATE IN "HIGH" POSITION BUT NOT IN "LOW" POSITION.			
Defective INST FLOOD switch, resistor or wiring.	**Note** Position INST FLOOD switch to "LOW" position. Check test point LFM to ground.	28 volts dc.	Replace defective resistor or attached wire.
		Zero volts.	Replace defective switch or power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. LIGHTS circuit breaker engaged.
INSTRUMENTS rheostat moved from "OFF" position toward "BRIGHT."

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WARNING LIGHTS CANNOT BE DIMMED.			
Defective warning light dimming relays, INSTRUMENTS rheostat or wiring.	Check test point LWA to ground. **Note** Refer to the applicable system for trouble shooting warning lights.	28 volts dc.	Replace defective warning light dimming relay(s) or wires to relay(s).
		Zero volts.	Replace defective INSTRUMENTS rheostat or power wire.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
INST. LIGHTS, INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS,
CONSOLE LIGHTS and CONSOLE FLOOD LIGHTS circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER FAILURE.			
Circuit-breaker failure.	Check test points PBC, PBE, PBF and PBG to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

8-97. INSTRUMENT AND CONSOLE REFRACTOR PANEL LIGHTS.

8-98. The refractor panels of the pilot's instrument panel and the left- and right-hand consoles have a non-gloss, black background with white lettering for maximum ease of reading. The lighting is accomplished by small lamp assemblies which are mounted to diffuse light through the plastic panels. (See figure 8-27.) These lamps are fitted with red filters to eliminate glare. All lamp assemblies in the refractor panels are powered from the primary bus through the CONSOLE LIGHTS circuit breaker and are controlled by the console rheostat (CONSOLE) located on the interior lights control panel of the right-hand forward console. To replace defective bulbs in the lamp assemblies, unscrew the top cap from the assembly and lift out. The bulb is contained in the top cap and can be pulled out with the finger tips.

8-99. INSTRUMENT POST AND SHIELD LIGHTS.

8-100. All instruments are illuminated by post lights and shield light assemblies with the exception of the stand-by compass and LABS timer indicator which have lamps mounted as an integral part of the instrument. Instruments with two post lights mounted near the edge of each instrument are the fuel flow indicator, fuel quantity indicator, tachometer indicator, exhaust temperature indicator and the hydraulic pressure indicator. The oxygen quantity indicator, range meter indicator, crystal current meter indicator and the cabin pressure altimeter indicator have one post light. The remote attitude indicator and the turn-and-bank indicator have four lamp shield light assemblies mounted around the faces of the instruments, with the remaining instruments having two lamp shield light assemblies, except the position indicators and the oil pressure indicator which are illuminated by refractor panel lights. On airplanes 143543! and subsequent and airplanes having Service Change No. 460 complied with, the three-position oil pressure indicator is replaced by a direct reading indicator. Illuminating of the direct reading oil pressure indicator is accomplished by two post lights. The right-hand post light serves a dual purpose by also illuminating the fuel flow indicator. (See figure 6-5.) The instrument lights are controlled by the instrument lights rheostat (INSTRUMENTS) located on the interior lights control panel. The brilliance of the stand-by compass and range meter indicator lights is controlled by the instrument lights rheostat (INSTRUMENTS) and the lights can also be turned "ON" or "OFF" by the stand-by compass and range meter indicator switch (STANDBY COMPASS & RANGE IND). For location of instrument lights and control panels, see figure 8-27.

8-101. FLOODLIGHTS.

8-102. Over-all lighting of the pilot's instrument panel and the left- and right-hand consoles is provided by red floodlights. Two floodlights are located on close-out panels at the sides of the pilot's instrument panel, and the third light is located at the forward edge of the right-hand forward console. These floodlights are powered by the INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS circuit breaker and are controlled by the instrument floodlight switch (INST FLOOD) located on the interior lights control panel. When the INST FLOOD switch is in the "HIGH" position, full primary d-c voltage is applied to the instrument floodlights. To reduce brilliance, place the INST FLOOD switch in the "LOW" position. The voltage applied to the instrument floodlights is reduced by inserting a 63-ohm resistor between the primary bus and the instrument floodlights. The INST FLOOD switch also has a center "off" position.

Note

The console lights rheostat (CONSOLE) must be turned on to supply voltage to the console floodlight switch.

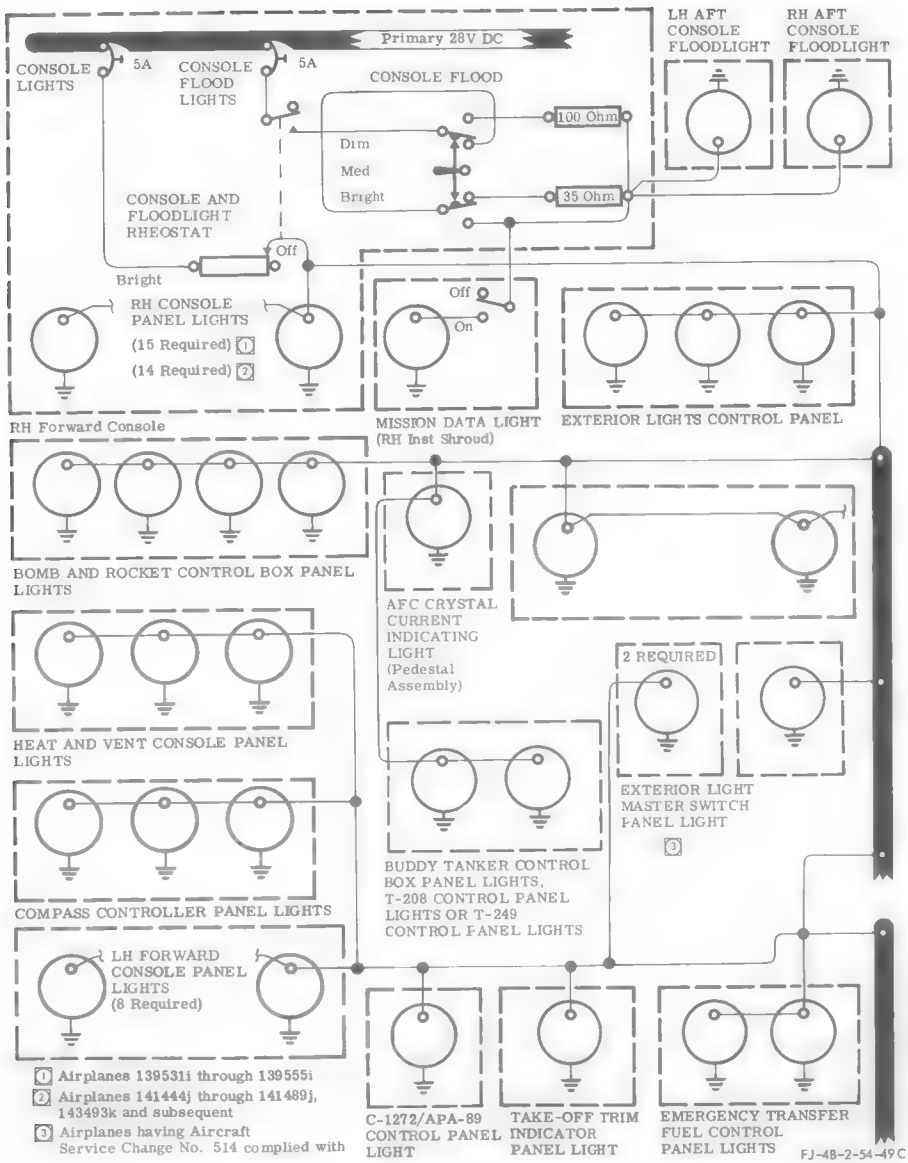
Floodlighting for the console panels is provided by a red floodlight mounted aft of each console panel. The console floodlights are controlled by the three-position console floodlight switch (CONSOLE FLOOD) located on the interior lights control panel. When the CONSOLE FLOOD switch is in the "DIM" position, a 100-ohm resistor is placed in series with the console floodlights. For medium brilliance, the CONSOLE FLOOD switch is placed in the "MED" position which inserts a 35-ohm resistor in series with the console floodlights. When the CONSOLE FLOOD switch is in the "BRIGHT" position, the full primary d-c bus voltage is applied to the console floodlights. The console floodlights may be disassembled for bulb replacement by unscrewing the large knurled nut located on one end of the floodlight assembly. There are two white unfiltered cockpit floodlights installed in the airplane. The cockpit floodlights are powered through the INST. FLOOD LIGHTS & COCKPIT FLOOD LIGHTS circuit breaker and are controlled by the two-position guarded cockpit floodlight switch (COCKPIT FLOOD) located on the interior lights control panel. When the COCKPIT FLOOD switch is in the "ON" position, full primary bus voltage is applied to the lights. The cockpit floodlights are located aft and above the left- and right-hand consoles. To replace defective cockpit floodlight bulbs, push in on the bulb and give a quarter turn counterclockwise; the bulb will pop out.

8-103. MISSION DATA LIGHT.

8-104. A red mission data light (figure 8-28) is installed on the right-hand side of the instrument shroud for use by the pilot as a knee-board illuminating light. The mission data light is controlled by the console lights rheostat (CONSOLE) and the console floodlight switch (CONSOLE FLOOD), with a knurl-type knob switch incorporated on the light assembly for "ON" or "OFF" operation. The swivel lens makes it possible for the pilot to adjust the light to the best suitable position.

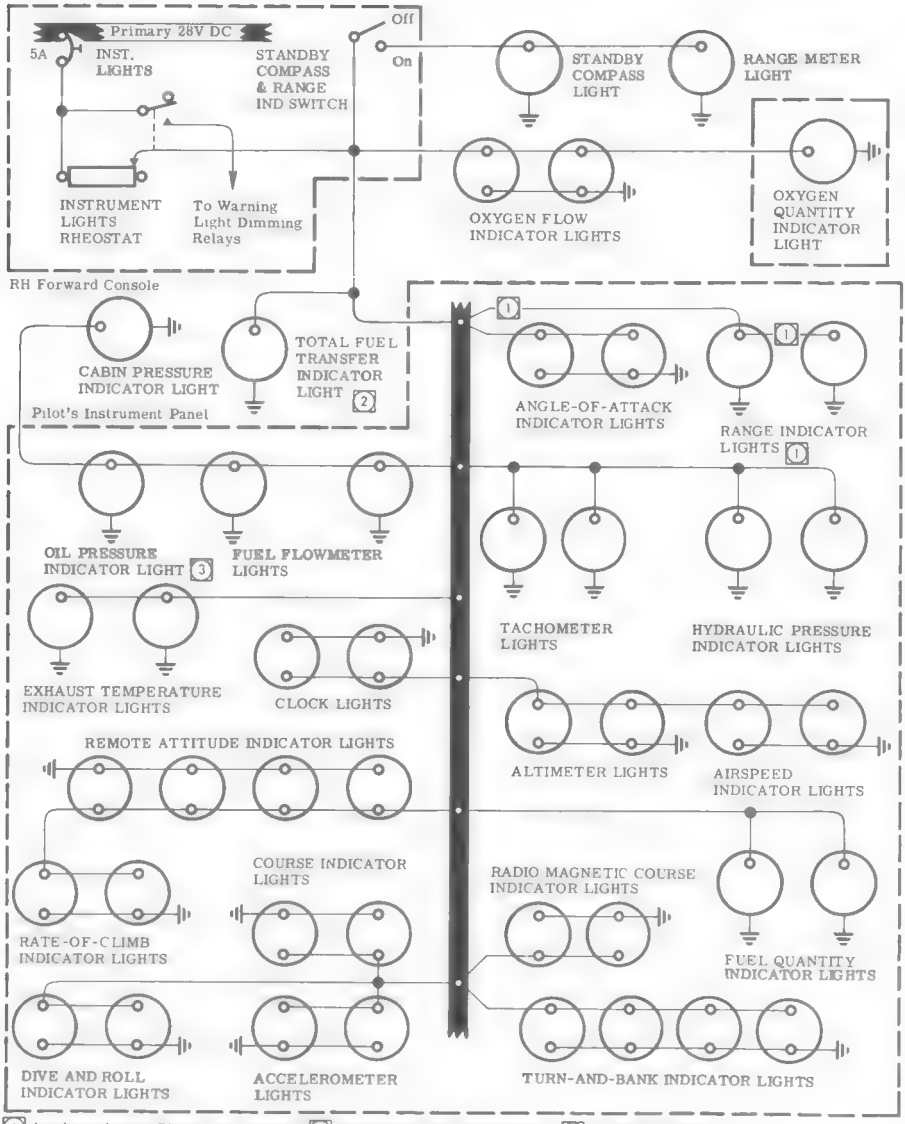
8-105. WARNING AND INDICATOR LIGHTS.

8-106. Warning and indicator lights are provided to give visual indication of equipment trouble or alternate operation of equipment. The brilliance of the warning and indicating lights with the exception of the fire



1 Airplanes 139531i through 139555i
2 Airplanes 141444j through 141489j, 143493k and subsequent
3 Airplanes having Aircraft Service Change No. 514 complied with

Figure No. 8-28. Interior Lights System (Sheet 1)



1 Airplanes having Phase II of Service Change No. 151 complied with

2 Installed as part of in-flight refueling tanker package

3 Airplanes 1435431 and subsequent

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Figure No. 8-28. Interior Lights System (Sheet 2)

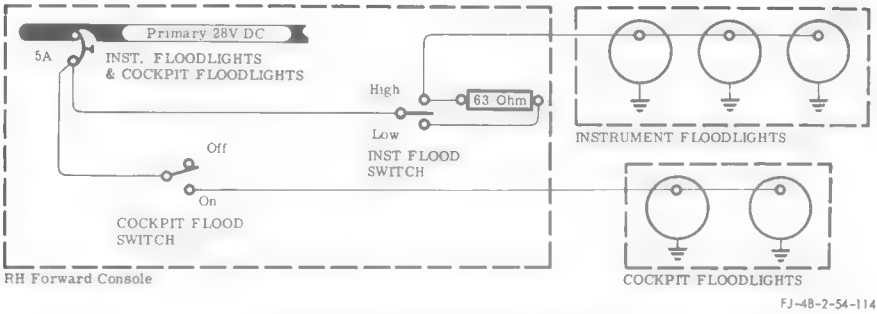


Figure No. 8-28. Interior Lights System (Sheet 3)

burner, fire compressor, and the arresting hook unsafe light, is automatically dimmed whenever the instrument lights rheostat (INSTRUMENTS), located on the right-hand console, is not in the "OFF" position. To replace warning light bulbs, pull plastic cover and replace bulb. Indicating light bulbs can be removed by unscrewing the cap assembly. For location, lettering and associated systems of the warning and indicator lights, refer to paragraph 6-25.

8-107. WARNING LIGHT TEST SWITCH. All warning lights can be checked by depressing the warning light test switch (WARNING LIGHT TEST) located on the right-hand forward console. When it is depressed, this switch energizes the 11 warning lights directly. The switch receives its voltage from the primary d-c bus through the WARNING LIGHT TEST & RUD. PED. SHAKER circuit breaker located on the right-hand forward console. For detailed information concerning operation of the individual warning lights, refer to the applicable system.

8-108. WARNING LIGHT DIMMING RELAY. The warning light dimming relay automatically dims the warning and indicating lights, with the exception of the two fire warning lights, the low oxygen warning light, the approach indexer and the arresting hook unsafe light. When the instrument lights rheostat (INSTRUMENTS) is placed in any position other than "OFF," the relay is actuated and dimming is accomplished by inserting a 63-ohm resistor in series with each affected light. The warning light dimming relay is located at fuselage station 86.0 below the pilot's floor. For schematic of the warning light dimming system, see figure 6-11.

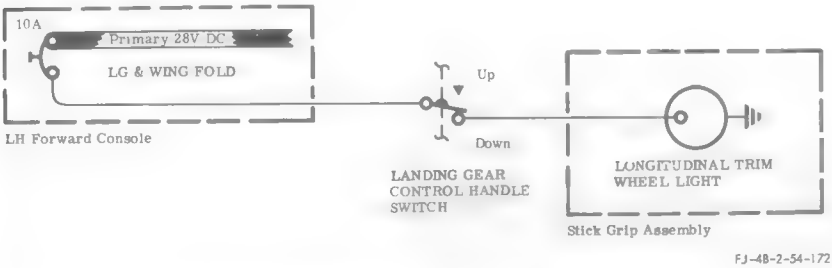


Figure No. 8-29. Longitudinal Trim Wheel Lighting System—
Airplanes 143493k and Subsequent

8-109. REMOVING AND INSTALLING WARNING LIGHT DIMMING RELAY.

REMOVING

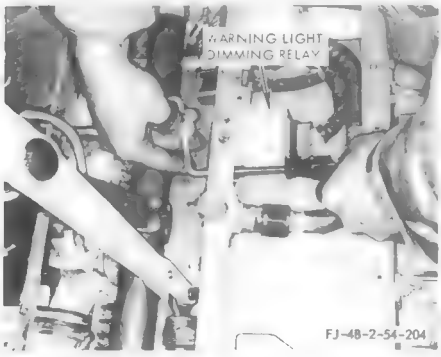
Caution Make sure no electrical power is applied to airplane.

1 Remove canopy. (Refer to paragraph 2-31.)

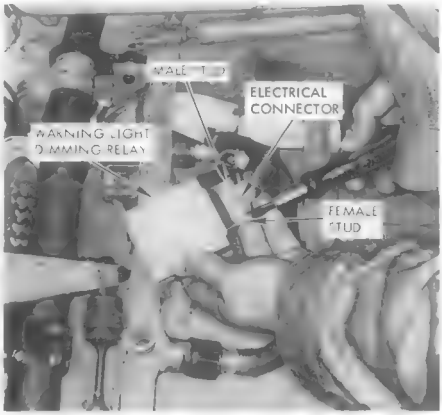
2 Remove pilot's seat. (Refer to paragraph 2-63.)

3 Remove cockpit floor to gain access to warning light dimming relay.

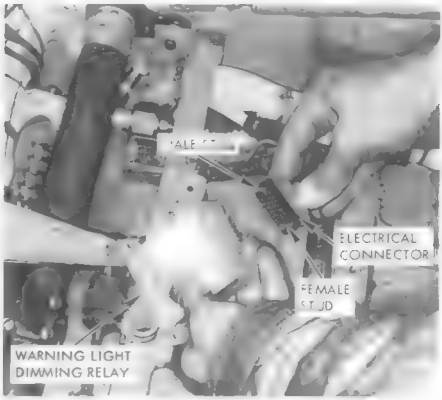
4 Remove four mounting screws and nuts securing relay.



5 Lift warning light dimming relay from mounted position and remove electrical connector by unscrewing two special-type studs.



Note When unscrewing studs, be sure to unscrew each stud alternately (a few threads at a time) so as not to damage relay pins. Studs are permanent installation of electrical connector and should be handled with care.



6 Remove warning light dimming relay from airplane.

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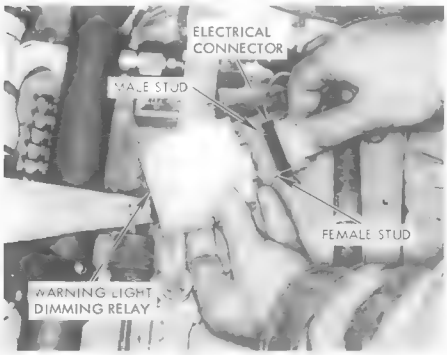
INSTALLING

1 Due to ease of maintenance, install electrical connector on warning light dimming relay before mounting relay.



Note The two electrical connector mounting studs consist of a female stud and a male stud to prevent reverse installation of the electrical connector.

2 Install electrical connector, tightening studs alternately (a few threads at a time).

Caution The male stud has been found to break due to overtorquing. A maximum of 2 inch-pounds torque should be applied when tightening studs.

3 Install relay in position and secure with four screws and nuts.

Caution Make sure ground wires are connected to the bottom right-hand mounting screw and the ground connections are clean and secure.

4 Perform operational check of warning light dimming system. (Refer to paragraph 8-106.)

Note When applying external power to airplane to perform operational check, make sure canopy actuator and d-c power switches are in the "OFF" position.

5 Replace cockpit floor, making sure area is clean before securing.

6 Install pilot's seat.

7 Install canopy.

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8-110. AUXILIARY WARNING LIGHT DIMMING RELAY. An auxiliary warning light dimming relay is located on fuselage station 86.0 under the pilot's floor next to the warning lights dimming relay. The auxiliary warning light dimming relay is used for dimming the oxygen low level warning light and, also, on airplanes 143594m and subsequent, for dimming the approach indexer. The auxiliary warning light dimming relay, containing no internal resistors, is mounted with a 500-ohm resistor to dim the oxygen low level warning light. On airplanes 143594m and subsequent, a resistor panel (AUXILIARY DIMMING RELAY RESISTORS) is installed. This panel contains a 500-ohm resistor to dim the oxygen low level warning light and three additional resistors (one for each bulb of the approach indexer) to dim the approach indexer. When the instrument lights rheostat (INSTRUMENTS) is placed in any position other than "OFF," dimming is accomplished in the circuit. See figure 6-11 for schematic of auxiliary warning light dimming system.

8-111. REMOVING AND INSTALLING AUXILIARY WARNING LIGHT DIMMING RELAY.

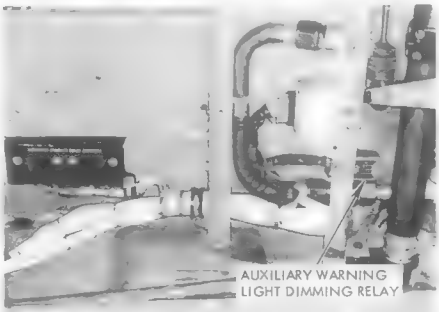
REMOVING

Caution Make certain no electrical power is applied to airplane.

1 Remove canopy. (Refer to paragraph 2-31.)

2 Remove pilot's seat. (Refer to paragraph 2-63.)

3 Remove cockpit floor to gain access to auxiliary warning light dimming relay.



4 Remove two screws securing auxiliary warning light dimming relay. One screw is located on relay side of rib and the other screw is located on the electrical connector side of rib.

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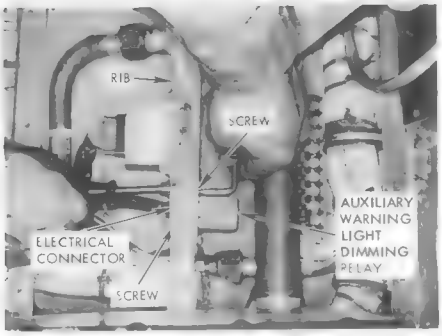
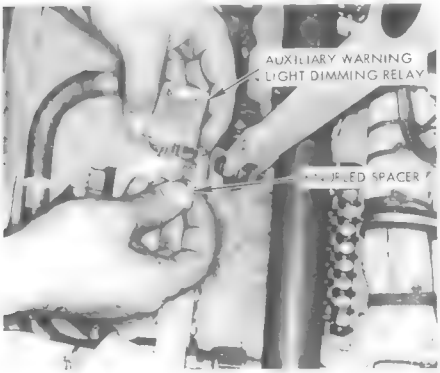


5 After removing two screws, pull auxiliary warning light dimming relay away from electrical connector. Connector will remain mounted to rib.

Caution When pulling relay from connector, take precaution so as not to damage relay pins.

6 If relay is to be replaced, remove the internally threaded knurled spacer and place on new relay.



7 To remove electrical connector, hold externally and internally threaded machine screw with an offset screwdriver and remove nut.

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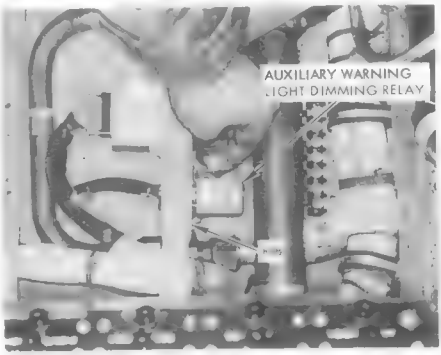
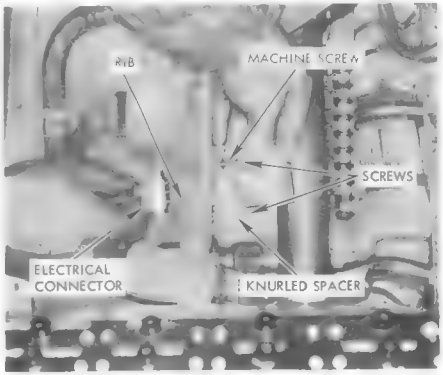
INSTALLING

Caution When installing relay into connector, be careful not to damage relay pins.

1 If electrical connector was not removed, install relay with knurled spacer attached and secure with plain spacer and screw. On relay side of rib, secure relay with screw. (See exploded views.)



2 If electrical connector was removed, install externally and internally threaded machine screw and knurled spacer on relay and secure with two screws.



3 Place electrical connector flush with rib and install relay. Knurled spacer and machine screw will run through rib and connector holes.

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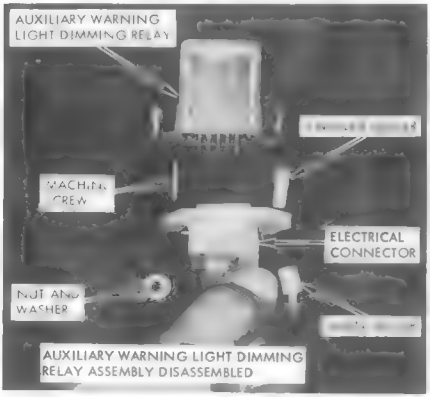
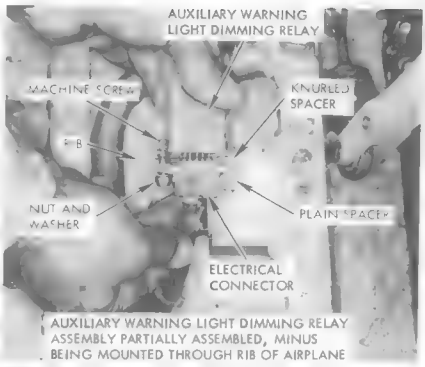
4 Secure relay by installing nut and washer on machine screw, and on knurled spacer insert a plain spacer and secure with screw.

Caution When installing nut on machine screw, be extremely careful not to run nut to end of threads. If relay does not secure before end of threads, insert extra washer. Do not overtorque nut or place strain on electrical connector.





5 Perform operational check of auxiliary warning light dimming system. (Refer to paragraph 8-111.)

Note When applying external power to airplane to perform operational check, make sure canopy actuator and d-c power switches are in the **"OFF"** position.

6 Replace cockpit floor, making sure area is clean before securing.

7 Install pilot's seat.

8 Install canopy.

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8-112. LONGITUDINAL TRIM WHEEL LIGHT—AIRPLANES 143493k AND SUBSEQUENT. The longitudinal trim wheel light is mounted within the stick grip and illuminates the longitudinal trim wheel whenever the landing gear is in the "DOWN" position. The trim wheel light is controlled by the landing gear control handle switch which energizes the light whenever the landing gear control handle is in the "DOWN" position and de-energizes the light whenever the landing gear control handle is in the "UP" position. See figure 8-29 for schematic of longitudinal trim wheel lighting system.

EXTERIOR LIGHTING SYSTEM

8-113. EXTERIOR LIGHTING SYSTEM.

8-114. The exterior lighting equipment consists of the top and bottom fuselage signal lights, the white fuselage formation lights, the red and green wing tip position lights, a landing light, an approach light, a white taillight, an exterior lights master switch, an exterior lights control panel and a Type F-1 flasher unit. For location of these lights, see figure 8-31.

8-115. FUSELAGE SIGNAL LIGHTS.

8-116. Two fuselage signal light assemblies are installed on the airplane. One lunar white assembly, mounted directly aft of the canopy, contains two bulbs: a 6-candle power bulb for dim operation and a 100-candle power bulb for bright operation. The other fuselage signal light assembly is clear and is mounted on the lower engine access door. The light contains one bulb with a double filament, one for dim operation and the other for bright operation. Fuselage signal lights operation is controlled by the flash-steady selector switch ("STDY" and "FLSH" positions) and the fuselage dim-manual-bright switch (FUSEL), which are located on the exterior lights control panel, and the exterior lights master switch (EXTERIOR LIGHTS) located forward of the power control lever on the left-hand forward vertical console. The flash-steady selector switch controls the fuselage signal lights in either the steady or flash mode of operation and the EXTERIOR LIGHTS master switch controls the "ON" and "OFF" operation of the lights. The fuselage signal lights switch (FUSEL) controls the brilliance and manual keying of the fuselage signal lights. Fuselage signal lights brilliance is adjusted by selecting either the 6- or 100-candle power bulb or the dim or bright filament. For manual signal operation, the FUSEL switch is placed in the "MAN" position with the EXTERIOR LIGHTS master switch in the "ON" position and the selector switch in the "STDY" position. Depressing the manual signal key (MAN KEY) causes the fuselage signal lights to flash at the manually keyed rate.

Note

During manual operation, the MAN KEY indicator light, located on the exterior lights control panel, will illuminate as the manual key is depressed.

Automatic flashing is obtained by placing the EXTERIOR LIGHTS master switch in the "ON" position, the flash-steady selector switch in the "FLSH" position and the FUSEL switch in either the "DIM" or "BRT" position. Under these conditions, the F-1 flasher unit is energized and alternately opens and closes the fuselage signal lights relay. The fuselage signal lights are powered through a relay on the exterior lights control panel for manual keying and through the fuselage signal light relay for automatic flashing. (See figure 8-30 for schematic of fuselage lighting system.)

8-117. FUSELAGE SIGNAL LIGHT BULB REPLACEMENT. To replace a defective bulb in the fuselage signal light assembly, the glass cover assembly must first be removed. Bulbs in the dorsal fuselage signal light are replaced as follows:

a. Remove the two round-head screws from each end of the light assembly cover.

b. Remove light assembly cover, taking care not to damage gasket.

c. Replace defective bulb with a good bulb.

d. Inspect cover gasket for damage and replace if necessary.

e. Install light assembly cover and light assembly cover screws.

The bulb in the bottom fuselage signal light is replaced as follows:

a. Remove the three flat head screws located around the perimeter of the light assembly cover.

b. Remove light assembly cover, taking care not to damage gasket.

c. Replace defective bulb with a good bulb. (See figure 8-32.)

d. Inspect cover gasket for damage and replace if necessary.

e. Install light assembly cover and light assembly cover screws.

8-118. WING TIP LIGHTS.

8-119. A wing tip light assembly is located on each wing tip. The light assembly located on the left wing tip has a red cover and the light assembly located on the right wing tip has a green cover. The operation of the wing tip lights is controlled by the exterior lights master switch (EXTERIOR LIGHTS) and the wing and taillight switch (WING & TAIL). The exterior lights master switch is located forward of the power control lever on the left-hand forward vertical console panel and the wing and taillight switch is located on the exterior lights control panel (EXTR LTS), on the right-hand forward console. The operating procedure of the wing tip lights is accomplished by placing the EXTERIOR LIGHTS master switch in the "ON" position and the WING & TAIL switch in any position other than "OFF." The wing and tail switch controls the brilliance of the wing tip lights by selecting either the "DIM" or "BRT" position. When the WING & TAIL switch is placed in the "DIM" position, a resistor is placed in series with the circuit to the wing tip lights, reducing the voltage applied to these lights.

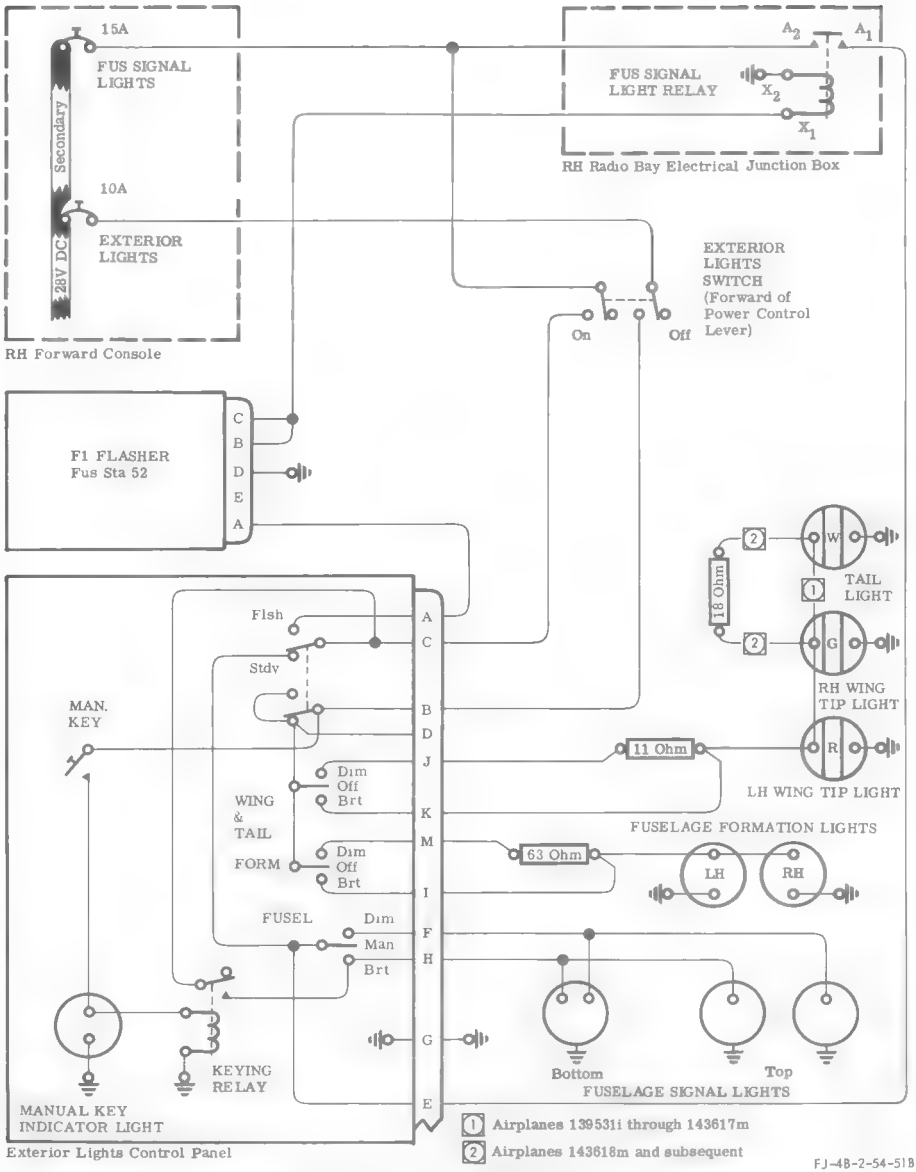


Figure No. 8-30. Exterior Lighting System

Placing the WING & TAIL switch in the "BRT" position by-passes the resistor and allows the wing tip lights to burn at full brilliance. The wing tip lights are powered by the secondary bus through the EXTERIOR LIGHTS circuit breaker. (See figure 8-30 for schematic.)

CAUTION

Ground operation of the wing tip lights must be limited to a maximum of 30 minutes with wings spread and 15 minutes with wings folded. If ground operation beyond these limits is necessary, allow a 15-minute cooling period between each operating period.

8-120. WING TIP LIGHT BULB REPLACEMENT. To replace defective bulbs in the wing tip light assemblies, proceed as follows:

a. Remove glass cover from the wing tip light by removing the four flat head mounting screws.

b. Replace defective bulb with a good bulb.

c. Reinstall glass cover on wing tip light.

CAUTION

Damage to wing tip light covers can occur from overtightening cover screws. Check for proper fit before tightening screws.

8-121. TAILLIGHT.

8-122. A white taillight is installed in the aft portion of the fuel vent outlet extending from the vertical stabilizer trailing edge. (See figure 8-31.) The operation of the taillight is controlled by the exterior lights master switch (EXTERIOR LIGHTS) and the wing and taillight switch (WING & TAIL). The exterior lights master switch is located forward of the power control lever on the left-hand forward vertical console panel. The wing and taillight switch is located on the exterior lights control panel (EXTR LTS), on the right-hand forward console. The operating procedure of the taillight is accomplished by placing the EXTERIOR LIGHTS master switch in the "ON" position and the WING & TAIL switch in any position other than "OFF." The wing and tail switch controls the brilliance of the taillight by selecting either the "DIM" or "BRT" position on the switch. When the WING & TAIL switch is placed in the "DIM" position, a resistor is placed in series with the circuit to the taillight, reducing the voltage applied to the taillight. Placing the WING & TAIL switch in the "BRT" position bypasses the resistor and allows the taillight to burn at full brilliance. On airplanes 143618m and subsequent, an additional 18-ohm resistor has been added to the taillight circuit. The added resistor dims the taillight when the WING & TAIL switch is in the "BRT" position. When selected to the "DIM" position, the original dimming resistor combines with the added resistor and provides dimming of the taillight to a greater degree. The taillight is powered by the secondary bus through the EXTERIOR LIGHTS circuit breaker. (See figure 8-30 for schematic.)

8-123. TAILLIGHT BULB REPLACEMENT. To replace a defective taillight bulb, proceed as follows:

a. Remove round-head screws located above and below lens.

b. Remove lens and lens bracket, taking care not to damage gasket or rubber washers.

c. Replace defective bulb with a good bulb. (See figure 8-32.)

d. Inspect gasket and rubber washers for damage and replace if necessary.

e. Place lens in position and install lens bracket.

f. Install round-head screws.

Note

When tightening screws, do not compress rubber washers more than 1/32 inch.

8-124. FORMATION LIGHTS.

8-125. Two formation light assemblies are installed in the airplane. A flush-type formation light assembly is located on each side of the fuselage aft of the fuselage break. The formation lights circuit is powered from the secondary bus through the EXTERIOR LIGHTS circuit breaker. The operation of the formation lights is controlled by the exterior lights master switch (EXTERIOR LIGHTS) and the formation light dim-bright switch (FORM). The exterior lights master switch is located forward of the power control lever on the left-hand vertical console and the formation light dim-bright switch is located on the exterior lights control panel on the right-hand forward console. With the EXTERIOR LIGHTS master switch in the "ON" position, the formation lights will operate when the FORM switch is positioned to either "DIM" or "BRT." The formation light dim-bright switch (FORM) is used either to control the brilliance of the formation lights or to turn them off. The FORM switch has a center "OFF" position for individual control. When the FORM switch is in the "DIM" position, a resistor is placed in series with the formation lights and reduces the voltage applied to the lights. Placing the FORM switch in the "BRT" position by-passes the resistor and applies full secondary bus voltage to the formation lights. See figure 8-30 for schematic of formation lighting system.

8-126. FORMATION LIGHT BULB REPLACEMENT. To replace defective bulbs in the fuselage formation lights, proceed as follows:

a. Remove the six flat head screws located on the visible portion of the light assembly.

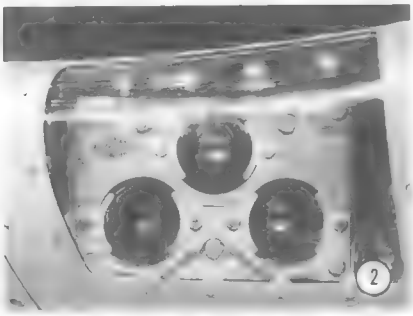
b. Remove light assembly cover, exposing globe.

c. Remove the two round-head screws which hold the globe in place.

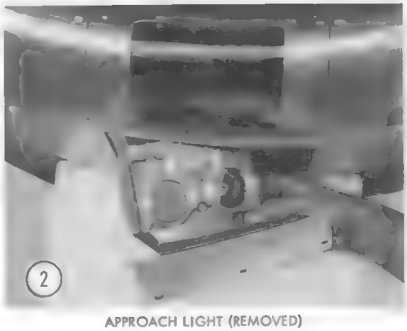
d. Remove globe bracket and globe, exposing bulb.

e. Replace defective bulb with a good one. (See figure 8-32.)

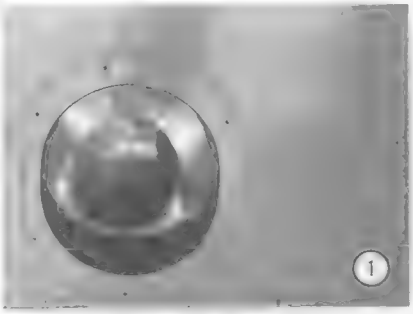
f. Install globe, globe bracket and globe bracket mounting screws.



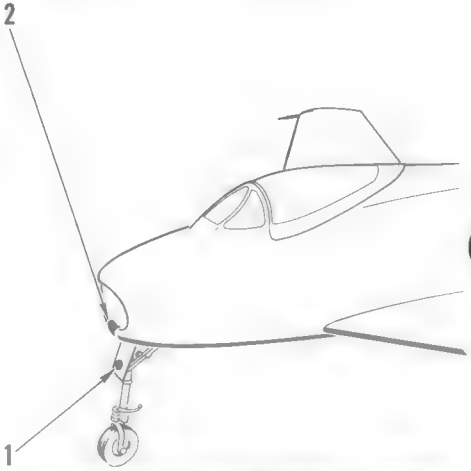
APPROACH LIGHT (INSTALLED)

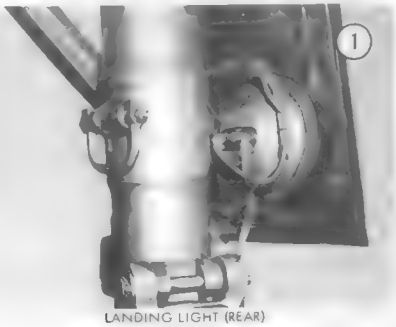


APPROACH LIGHT (REMOVED)

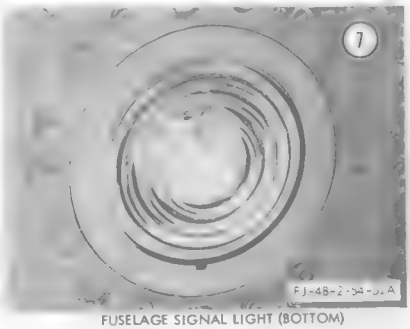


LANDING LIGHT (FRONT)



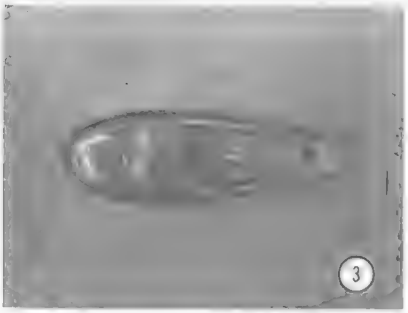


LANDING LIGHT (REAR)

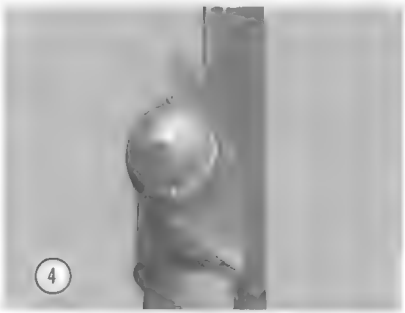


FUSELAGE SIGNAL LIGHT (BOTTOM)

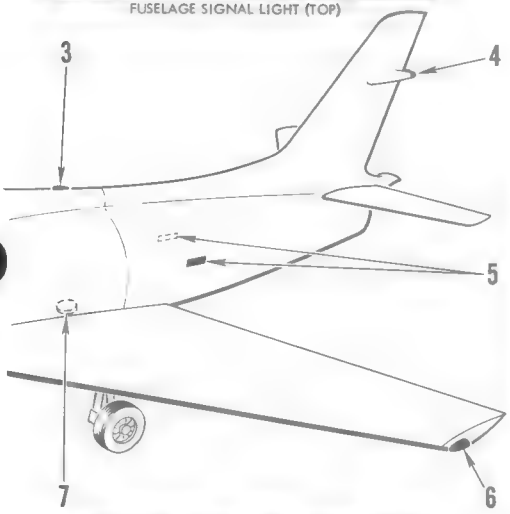
Figure No. 8-31. Exterior Lighting System Location (Sheet 1)

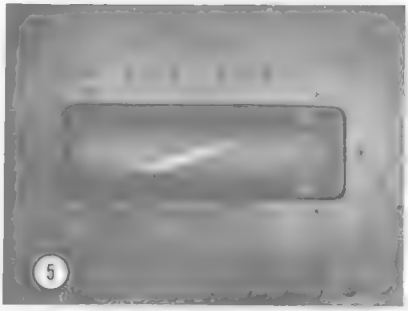


FUSELAGE SIGNAL LIGHT (TOP)

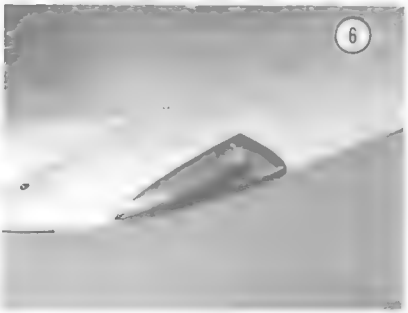


TAILLIGHT





LH AND RH FUSELAGE FORMATION LIGHTS



LH WING TIP LIGHT (INSTALLED), RH OPPOSITE

LH WING TIP LIGHT (REMOVED), RH OPPOSITE

Figure No. 8-31. Exterior Lighting System Location (Sheet 2)

LIGHT	ASSEMBLY NUMBER	REPLACEMENT BULB NUMBER
EXTERIOR		
APPROACH	D7220B	A-7796-24 GRIMES
LANDING		4580 GE
WING TIP POSITION		
LEFT WING	D7670-1	A7512 GRIMES
RIGHT WING	D7670-2	A7512 GRIMES
FUSELAGE FORMATION	D5730A-5	AN3121-313
TAILLIGHT	AN3158-1	AN3124-307
FUSELAGE SIGNAL		
TOP - DIM	G7005-4	AN3131-303
BRIGHT	G7005-4	AN3120-1047
BOTTOM	D6975-1	1048 GRIMES
INTERIOR		
MISSION DATA	B9685-1	AN3121-313
CONSOLE PANEL	MS25010-2A MS25010-4A	AN3140-327 AN3140-327
COCKPIT FLOOD	A4950A-1	1385 GE
CONSOLE FLOOD	A4255A	AN3131-303
INSTRUMENT FLOOD	A4255A-2 A6100	AN3131-303 1495 GRIMES
INSTRUMENT PANEL	MS25010-4A	AN3140-327
LONGITUDINAL TRIM WHEEL		AN3140-327

LIGHT	ASSEMBLY NUMBER	REPLACEMENT BULB NUMBER
WARNING		
WARNING		AN3121-313
OXYGEN LOW LEVEL	A3074R	AN3140-327
LANDING GEAR		AN3136R-323
INSTRUMENT	A5299	334 GE
POST	A6745	AN3140-327
	A7505	AN3140-327
	A6795	AN3140-327
	A6815	AN3140-327
SHIELD	B4789	334 GE
	B4876-R	334 GE
	B6600	AN3140-327
	B6601	AN3140-327
	B8728	AN3140-327
EXTERNAL LIGHTS MASTER SWITCH (1)	244-954027 (NAA)	AN3140-327
	B8720-R	AN3140-327
	B8728	AN3140-327
	B8725	AN3140-327
STORE AND TANK JETTISON (1)	244-954027 (NAA)	AN3140-327
STAND-BY COMPASS		AN3140-327

(1) AIRPLANES HAVING AIRCRAFT SERVICE CHANGE NO. 514 COMPLIED WITH

FJ-4B-2-54-50C

Figure No. 8-32. Light Bulb Replacement Data

g. Install light assembly cover and the six flat head screws.

8-127. FLASHER UNIT.

8-128. A Type F-1 flasher unit, located in the right-hand forward corner of the radar bay, provides automatic flashing of the fuselage signal lights. The flasher unit is energized when the EXTERIOR LIGHTS master switch is placed in the "ON" position and the flash-steady selector switch is placed in the "FLSH" position. Contacts inside the flasher unit route power impulses to the coil of the fuselage signal lights relay, which completes a circuit to the fuselage signal lights, causing the lights to flash.

8-129. REMOVING FLASHER UNIT. To remove the flasher unit, proceed as follows:

a. Make certain no power is applied to the system.

b. Remove radar bay access door and locate flasher unit in right-hand forward corner of radar bay.

c. Remove cable connection to flasher unit.

d. Remove mounting screws and carefully lift out flasher unit.

8-130. INSTALLING FLASHER UNIT. To install the Type F-1 flasher unit, proceed as follows:

a. Make certain no power is applied to the system.

b. Place flasher unit in position and install mounting screws.

c. Install cable connection to flasher unit.

d. Install radar bay access door.

8-131. FUNCTIONAL CHECK OF FLASHER UNIT. To make a functional check of the flasher unit, proceed as follows:

a. Place EXTERIOR LIGHTS master switch to the "ON" position.

b. Place FUSEL switch to "BRT" position and observe fuselage signal lights flashing. Lights should flash instantaneously and with equal time intervals for each position.

c. Replace flasher unit if flashing does not occur in equal intervals.

d. Return all switches to "OFF" positions.

8-132. APPROACH LIGHT.

8-133. An approach light is located in the lower leading edge of the air intake duct. The approach light indicates three conditions to the landing signal officer

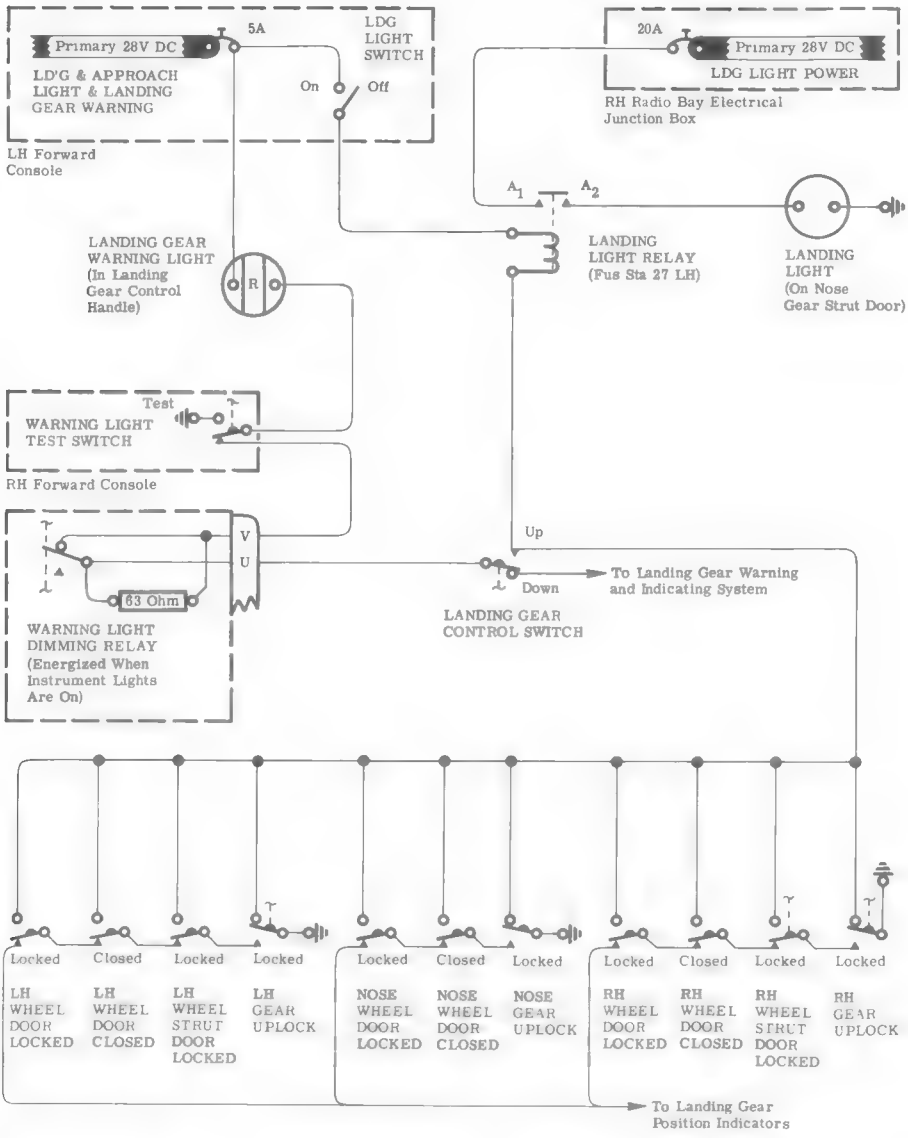


Figure No. 8-33. Landing Light System

(LSO). If the light is on, it is an indication that the landing gear is down and locked and the arresting hook is down. The color of the light indicates the relative angle of attack of the airplane on final approach to landing. There are three bulbs in the approach light and each bulb has two filaments: one bright for day operation and one dim for night operation. The brilliance of the light is controlled by the approach light relay. The approach light receives its power from the secondary bus through the angle-of-attack system. Two cam-operated microswitches in the angle-of-attack indicator route power to the red, amber or green indicating bulb, depending upon the angle of attack of the airplane. For further information on the approach light, refer to paragraph 6-235.

8-134. APPROACH LIGHT BULB REPLACEMENT. To replace defective bulbs in the approach light, proceed as follows:

a. Make certain no power is applied to the system.

b. Remove the three flat head screws directly under the approach light assembly.

c. Remove approach light assembly as shown in figure 8-31.

d. Replace defective light bulb with a good one. (See figure 8-32.)

e. Install approach light assembly.

8-135. APPROACH LIGHT RELAY. The approach light relay controls the brilliance of the approach light for day or night operation. Power to the relay coil is controlled through the exterior lights master switch. When the EXTERIOR LIGHTS master switch is "OFF," the relay coil is de-energized and current flows to the bright filament of the approach light bulb. When the EXTERIOR LIGHTS master switch is in the "ON" position, the relay is energized and current flows to the dim filament of the approach light bulb. The approach light relay is mounted on the bulkhead aft of the approach light assembly.

8-136. LANDING LIGHT.

8-137. A landing light is installed on the nose wheel fairing door. The landing light switch (LDG LIGHT), located on the left-hand forward console immediately forward of the engine control panel, is of the lever locking-type. Placing the LDG LIGHT switch to the "ON" position, with the landing gear control handle switch down and the gear down and locked, energizes the landing light relay. The landing light relay completes a circuit from the primary bus to the landing light through the LDG LIGHT POWER circuit breaker. For schematic of landing light system, see figure 8-33.

8-138. REMOVING LANDING LIGHT. To remove landing light, proceed as follows:

a. Remove wires from lamp. Tape and stow wires if necessary.

b. Remove top bolt which secures support assembly and wire bundle to landing light bracket.

c. Remove bottom bolt which secures support assembly to landing light bracket.

d. Remove landing light assembly.

8-139. INSTALLING LANDING LIGHT. To install landing light, proceed as follows:

a. Place gasket around outer edge of lamp.

b. Install support assembly housing and band on lamp.

c. Place landing light assembly in position and install lower bolt.

d. Install upper bolt, securing wire bundle and support assembly to landing light bracket.

e. Install landing light wires.

8-140. ADJUSTING LANDING LIGHT. To adjust the landing light, proceed as follows:

a. Loosen top and bottom adjusting bolts.

b. Move top of landing light forward until top adjusting bolt is at the extreme aft end of the slot.

c. While holding top of landing light in position, move bottom until the center of the bottom adjusting bolt is 7/16 inch from the forward end of slot. Tighten bottom adjusting bolt.

d. Make certain that top mounting pin is secure; otherwise, landing light adjustment will be unstable.

8-141. TROUBLE SHOOTING EXTERIOR LIGHTING SYSTEM.

TEST EQUIPMENT: D-C voltmeter.
Ohmmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
EXTERIOR LIGHTS switch in "ON" position.
FUS SIGNAL LIGHTS circuit breaker engaged.
Selector switch in "STDY" position.
FUSEL switch in "BRT" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUSELAGE SIGNAL LIGHTS FAIL TO ILLUMINATE.			
Defective lamps, light assemblies or wiring.	Check test point LEA to ground.	28 volts dc.	Replace lamps, light assemblies or wiring to assemblies.
		Zero volts.	Continue trouble shooting.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUSELAGE SIGNAL LIGHTS FAIL TO ILLUMINATE. (Cont)			
Defective EXTERIOR LIGHTS switch or wiring.	Check test point LEB to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective EXTERIOR LIGHTS switch or power wire.
Defective exterior lights control panel or wiring.	Check between test points LE1 and LE2.	Zero ohms.	Replace wire to test point LEA.
		Zero ohms.	Replace exterior lights control panel.

TEST EQUIPMENT: Ohmmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
EXTERIOR LIGHTS switch in "ON" position.
FUS SIGNAL LIGHTS circuit breaker engaged.
Selector switch in "FLSH" position.
FUSEL switch in "BRT" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUSELAGE SIGNAL LIGHTS BURN STEADY BUT WILL NOT FLASH.			
Defective exterior lights control panel.	Check between test points LE1 and LE3 and between test points LE2 and LE4.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective exterior lights control panel.
Defective wiring.	Check test point LEC to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire to control panel.
Defective FUS SIGNAL LIGHT relay, flasher unit or wiring.	Check test points LED and LEE to ground.	28 volts dc at both test points LED and LEE.	Replace FUS SIGNAL LIGHT relay.
		Zero volts at test point LED.	Replace flasher or defective wire to flasher.
		Zero volts at test point LEE.	Replace defective power wire.
FUSELAGE SIGNAL LIGHTS FLASH MORE THAN THE NORMAL FLASHING RATE.			
Defective flasher unit.			Replace flasher unit.
FUSELAGE SIGNAL LIGHTS BURN STEADY WHEN FLASH POSITION IS SELECTED.			
Defective flasher unit.			Replace flasher unit.

Note

Above troubles can occur for the "DIM" position of the FUSEL switch. To trouble shoot under these conditions, substitute test point LEF for test point LEA and test point LE5 for test point LE2 in the corresponding isolation procedure.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
EXTERIOR LIGHTS circuit breaker engaged.
EXTERIOR LIGHTS switch in "ON" position.
WING & TAIL switch positioned to "BRT."

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WING AND TAILLIGHTS FAIL TO ILLUMINATE.			
Defective EXTERIOR LIGHTS switch or wiring.	Check test point LEG to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective EXTERIOR LIGHTS switch or power wire.
Defective exterior lights control panel.	Check between test points FL2 and LEG.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective exterior lights control panel.
Defective wiring.	Check test point LEH to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective wire segment to exterior lights control panel.
Defective lamp, light assembly or wiring.	Check test point LEJ to ground.	28 volts dc.	Replace defective right-hand wing tip lamp or light assembly.
		Zero volts.	Replace defective wire segment to test point LEH.
	Check test point LEK to ground.	28 volts dc.	Replace defective left-hand wing tip lamp or light assembly.
		Zero volts.	Replace defective wire segment to test point LEH.
	Check test point LEL to ground.*	28 volts dc.	Replace defective taillight lamp or light assembly.
		Zero volts.	Replace defective wire segment to test point LEH.
Defective taillight lamp, light assembly, resistor or wiring.†	Check test point LEL to ground.	19 volts dc.	Replace defective taillight lamp or light assembly.
		Zero volts.	Continue trouble shooting.
	Check test point LEV to ground.	28 volts dc.	Replace defective resistor wire segment to test point LEL.
		Zero volts.	Replace defective wire segment to test point LEH.

SYSTEM CONDITIONS: No d-c power applied to airplane.
WING & TAIL switch in "DIM" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WING AND TAILLIGHTS BURN BRIGHT WHEN DIM POSITION IS SELECTED.			
Defective exterior lights control panel.	Check between test points FL2 and LE7.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective exterior lights control panel.

*Airplanes 139531i through 143617m
†Airplanes 143618m and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WING AND TAILLIGHTS BURN BRIGHT WHEN DIM POSITION IS SELECTED. (Cont)			
Defective wiring.	Check between test points LEM and LEN.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective wire.
Defective resistor.	Check between test points LEN and LEP.	11 ohms.	No action.
		Other than 11 ohms.	Replace defective resistor.

TEST EQUIPMENT: D-C voltmeter.
Ohmmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
EXTERIOR LIGHTS switch in "ON" position.
EXTERIOR LIGHTS circuit breaker engaged.
FORM switch in "BRT" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FORMATION LIGHTS FAIL TO ILLUMINATE.			
Defective wiring.	Check test point LEG to ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective power wire.
Defective exterior lights control panel.	Check between test points FL2 and LE8.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective exterior lights control panel.
Defective lamp, light assembly or wiring.	Check test point LEQ to ground.	28 volts dc.	Replace defective lamp or light assembly.
		Zero volts.	Replace defective wire segment to exterior lights control panel.
	Check test point LER to ground.	28 volts dc.	Replace defective lamp or light assembly.
		Zero volts.	Replace defective wire segment to exterior lights control panel.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
EXTERIOR LIGHTS switch in "ON" position.
EXTERIOR LIGHTS and FUS SIGNAL LIGHTS circuit breakers engaged.
Selector switch in "FLSH" position.
FUSEL switch in "MAN" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUSELAGE SIGNAL LIGHTS OPERATE IN "STDY" OR "FLSH" POSITION BUT NOT IN "MAN" POSITION.			
Defective keying circuit.			Replace defective control panel.

TEST EQUIPMENT: Ohmmeter.

SYSTEM CONDITIONS: FORM switch in "DIM" position.
No d-c power applied to airplane.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FORMATION LIGHTS BURN BRIGHT WHEN DIM POSITION IS SELECTED.			
Defective exterior lights control panel.	Check between test points FL2 and LE9.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective exterior lights control panel.
Defective wiring.	Check between test points LES and LET.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective wire.
Defective resistor.	Check between test points LET and LEU.	63 ohms.	No action.
		Other than 63 ohms.	Replace defective resistor.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
FUS SIGNAL LIGHTS circuit breaker engaged.
EXTERIOR LIGHTS circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
POWER FAILURE.			
Defective circuit breaker.	Check test points PBS and PBT to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

8-142. TROUBLE SHOOTING LANDING LIGHT SYSTEM.

TEST EQUIPMENT: D-C voltmeter.
Ohmmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
LDG LIGHT POWER and LDG & APPROACH LIGHT & LANDING GEAR WARNING circuit breakers engaged.
LDG LIGHT switch in the "ON" position.
Gear down and locked.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO LANDING LIGHT ILLUMINATION.			
Defective landing light.	Check test point LLA to ground.	28 volts dc.	Replace landing light.
		Zero volts.	Continue trouble shooting.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO LANDING LIGHT ILLUMINATION. (Cont)			
Defective landing light switch, relay or wiring.	Check between test points LLB and LLC and ground and between test points LLC and LLD. **Note** Test point LLC is positive.	28 volts dc.	Replace landing light relay.
		Zero volts at test point LLB.	Replace defective power wire.
		Zero volts at test point LLC.	Replace defective landing light switch or power wire.
		Zero volts between test points LLC and LLD.	Continue trouble shooting.
Defective landing gear and door uplock switches or wiring.	Check test point LLE to ground.	Zero ohms.	Replace defective wire to test point LLD.
		Other than zero ohms.	Perform a wire segment continuity check of landing gear and door uplock switches and rerig or replace defective uplock switches as required. Refer to paragraph 3-117 for rerigging of switches.
POWER FAILURE.			
Defective circuit breaker.	Check test points PHE and PDM to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

ALPHABETICAL INDEX

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